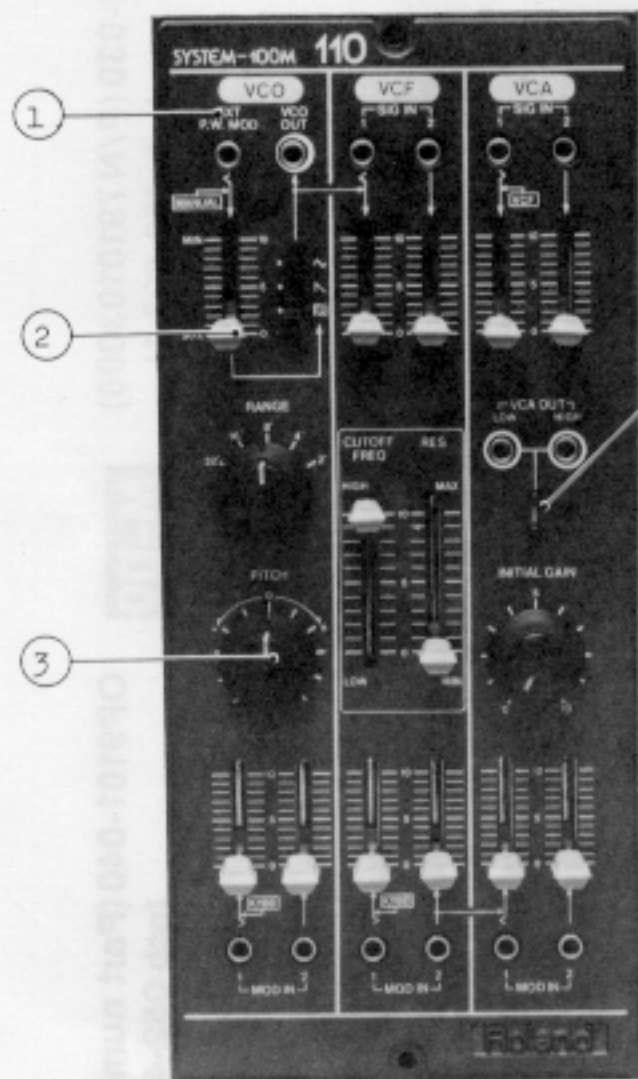


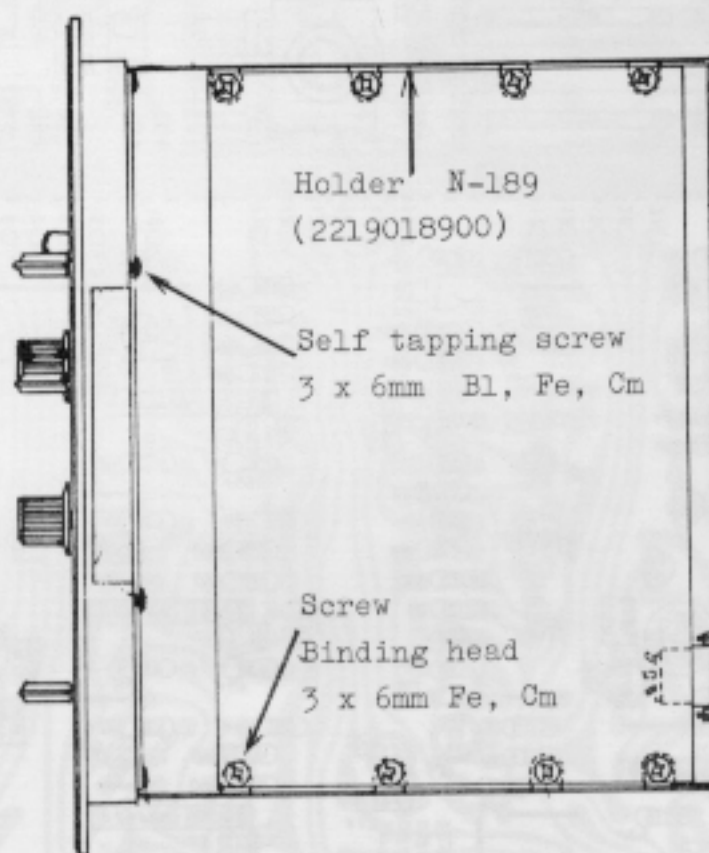
SYSTEM 100M SERVICE NOTES

First Edition



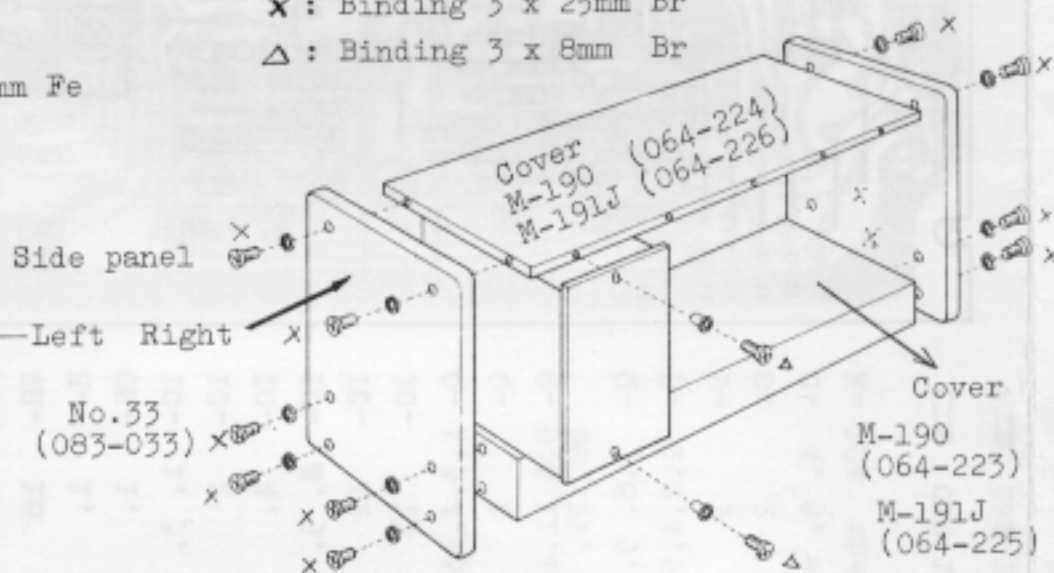
Pictures on this page represent parts common to modules and similarities.

For ①-④, see list at the right.

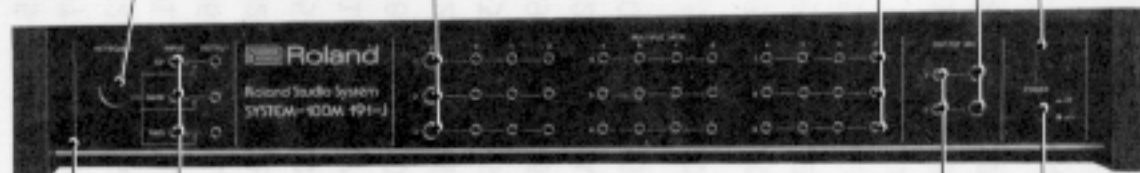


x : Binding 3 x 25mm Br
△ : Binding 3 x 8mm Br

Cover N-122 (2201012200) Binding head 3 x 6mm Fe



M-191J



Twin pin jack
P-254P-4
(009-016)

DIN socket 8P
CS0690-1-1
(13429603)

Chassis

M-190: No.222 (061-222)
M-191J: No.221 (061-221)

Panel M-190: No.231 (072-231)

M-191J: No.234 (072-234)

M-191J	
①	N-19 22210 19300
②	K 13
③	K 3
④	G 1 G L 1

Jack SC
(009-016)

Knob No.
Pot.
VMIORKL
(028-71)

Switch
SLE-623
(131391)

Pot.
VMIORKL
(028-71)

Cabinet

Jack
DIN



PB-4

Power
SDG5E
SDG5E
SDG5E

Parts are designated in New numbering (8-10 digits) and/or Old (6 digits).

"N" heading abbreviated new number stands for NEW.

When ordering replacement, use "No." for only old one.

Each figure, 0-13, at lower line in (2) - (4) indicates part per module.

	M-110	M-112	M-121	M-130	M-131	M-132	M-140	M-150	M-172	M-182
①	N-193 22210-19300	N-195 22210-19500	N-197 22210-19700	N-198 22210-19800	N-199 22210-19900	N-200 22210-20000	N-201 22210-20100	N-203 22210-20300	N-204 22210-20400	N-205 22210-20500
②	K n o b N o . 7 9 0 1 6 - 0 7 9 2 2 4 7 0 1 2 9 0 0 N - 1 2 9									
	13	10	16	12	4	10	10	4	0	0
③	K n o b N o . 7 8 0 1 6 - 0 7 8 2 2 4 7 0 1 2 8 0 0 N - 1 2 8									
	3	4	0	2	1	0	1	1	10	1
④	G L - 3 A R - 1 (red) (019-022)								GL-3AR-2 (red)	
	1	0	2	2	3	2	1	1	019-020	
	G L - 3 P G - 1 (green) (019-023) 15029111								15029109	
	1	0	2	2	0	0	0	0	2	8

Jack SG-8050#4
(009-007)

Knob No.44 (016-044)
Pot.
VM10RK15B15(L)
(028-727)

Switch
SLE-623-12P(S)
(13139131)

Pot.
VM10RK15A26(L)
(028-756)

Removal screws

Top cover: 3.1 x 10mm wood, RH, Br
Cabinet (side): 3 x 25mm binding, Br
Cabinet (bottom): 4 x 15mm truss, Br

Top cover No.205 (065-205)

Cabinet No.122
(081-122)

Endblock No.242
(072-242)

Keyboard SK-132B
(004H006)

KEY ASSEMBLY
F (IVORY) (106-015)
G (IVORY) (106-016)
A (IVORY) (106-017)
B (IVORY) (106-018)
C (IVORY) (106-019)
D (IVORY) (106-020)
E (IVORY) (106-021)
F' (IVORY) (106-022)
SHARP (BLACK) (106-023)

M-180

Base No.20 (foot)
(111-020)

Cabinet No.155 (081-155)

Panel No.241
(072-241)

Jack HLJ-102-r-4 (13449111)
DIN socket CS-660-1-1 6P (012-036)

M-181

Top cover No.206
(065-206)



Keyboard SK-192B (004H007)

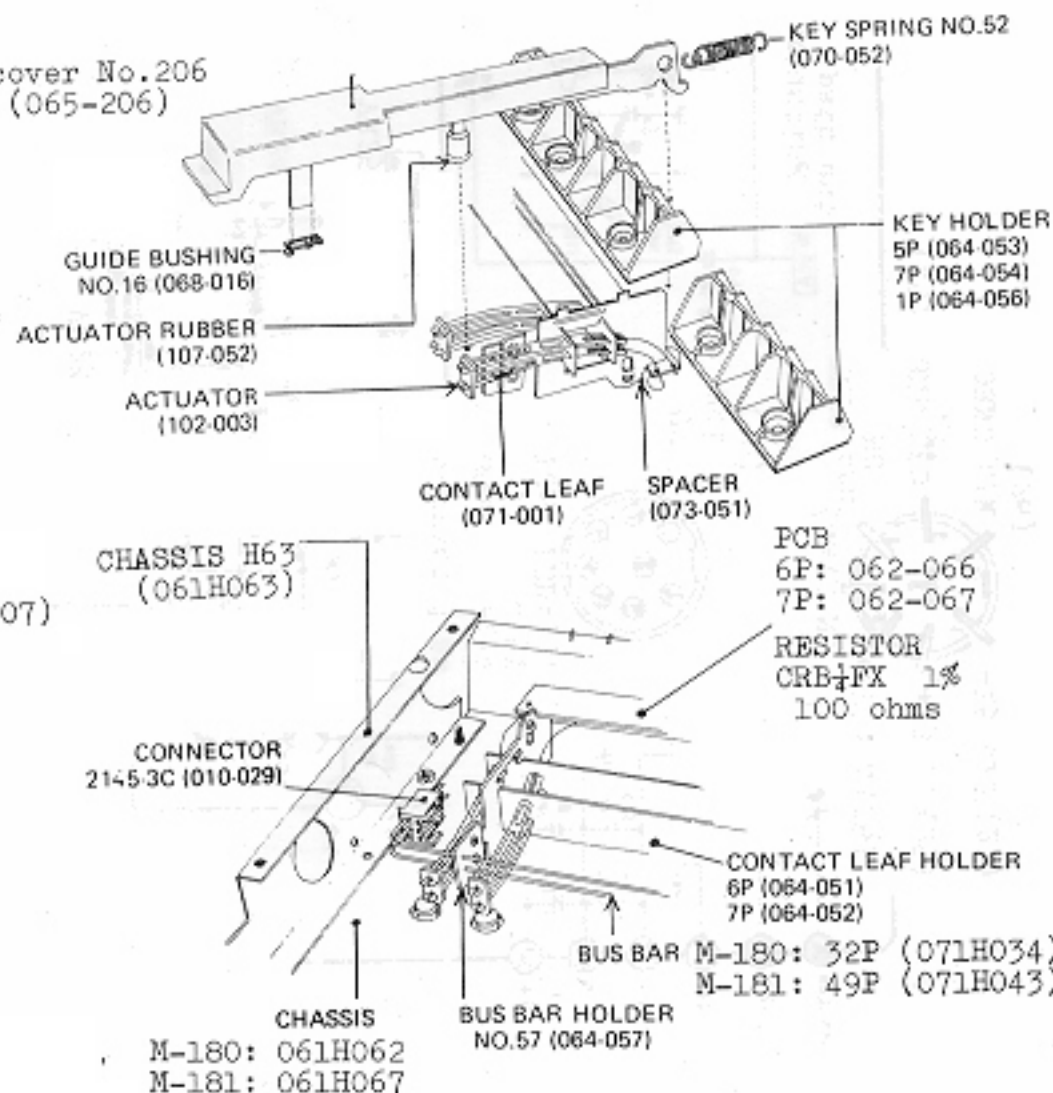
Panel No.233 (072-233)

Switch SLE-622-12P(S) (13139130)

PB-4 (029-022)

Power switch

SDG5P-001-1 (13129101) 100V
SDG5P-001-2 (13129102) 117V
SDG5P-502 (13129103) 220/240V



OP9101-030 (P/N 7910103000)
(pcb 052-403-1)

M-110

OP9101-040 (Part number 7910104000)
(pcb 052-403-2)

NOMENCLATURE

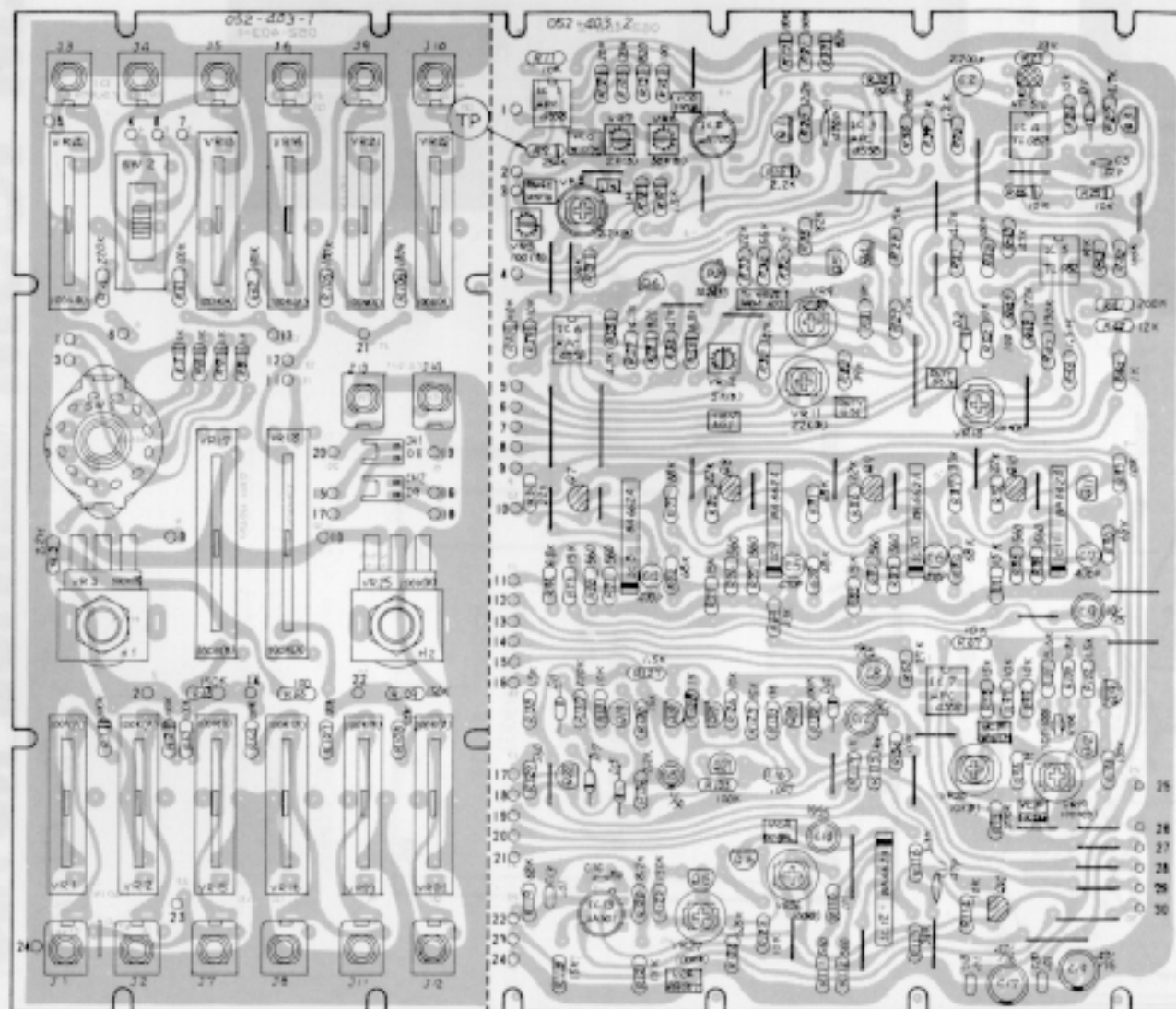
PART NO.

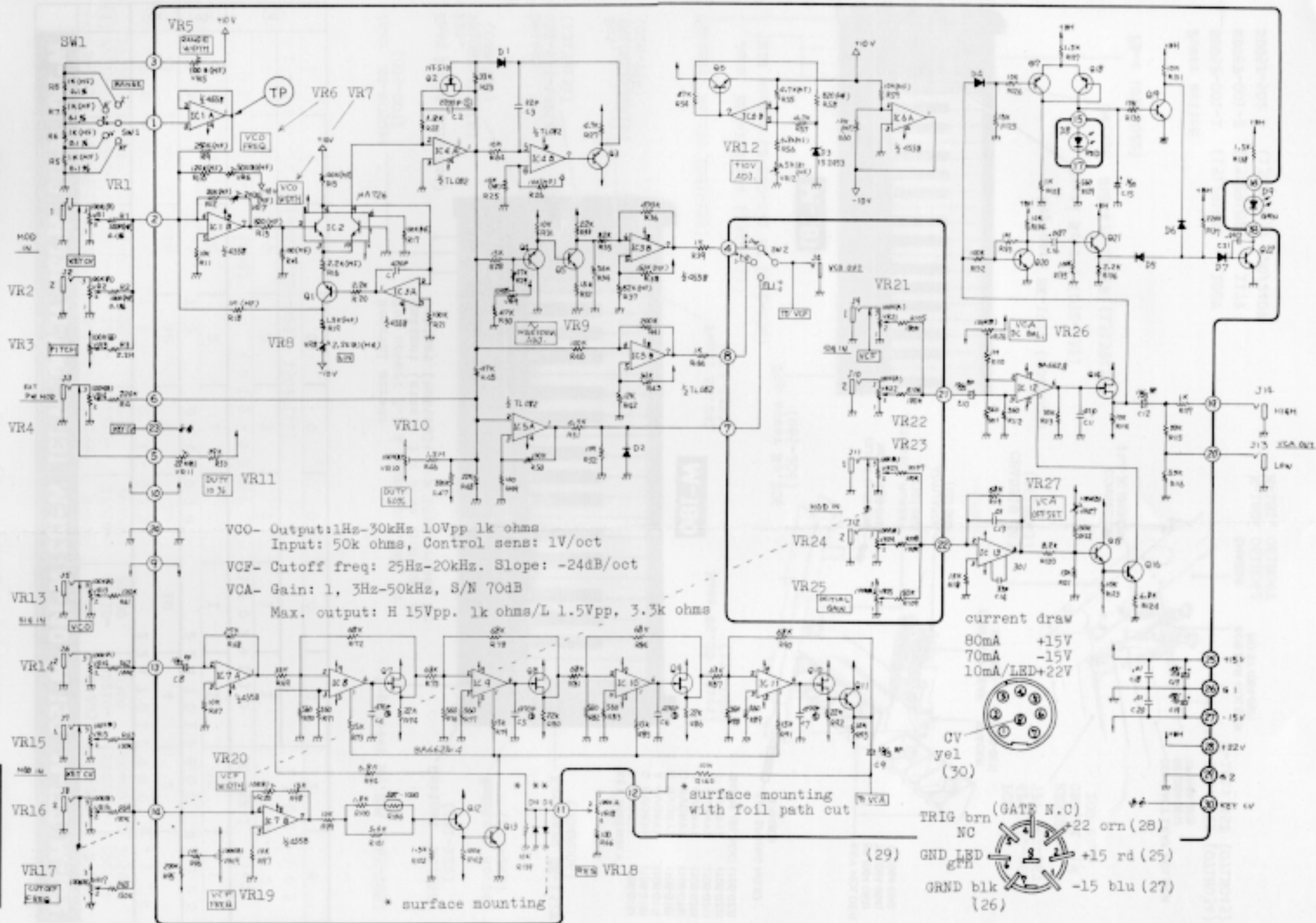
MANUFACTURE NAME

J- 1-16	13449402	SJ-409-1-2
SW- 1	13119401	SRM1025172
SW- 2	13159304	SSB02335
VR- 1,2,13,14,21,22	13339301	EVA-HO4C15A15
VR- 3, 25	13219220	VM10RB10C K20 100KB
VR- 4,15,16,23,24	13339304	EVA-HO4C15B15
VR- 5	13299501	PN822H101H
VR- 6	13299508	PN822H503H
VR- 7	13299504	PN822H202H
VR- 8	13299542	CR19R 2.2KB
VR- 9, 20	13299114	SR19R 10KB
VR- 10,19,26,27	13299117	SR19R 100KB
VR- 11	13299115	SR19R 22KB
VR- 12	13299507	PN822H502H
VR- 17	13339402	EVA-TOAC15B15
VR- 18	13339401	EVA-TOAC15A15
H- 1, 2	2219510600	Holder N-106
CN- 1, 2	13439502	3024-02C
IC- 1, 3, 6, 7	15189105	uPC4558C
IC- 2	15219101	uA726HC
IC- 4, 5	15189118	TLO82CP
IC- 8, 9, 10, 11	15229802	BA662-A
IC- 12	15229803	BA662-B
IC- 13	15189109	uA301HC
Q- 1,3,4,13,16,17,18	15119112	2SA1015-Y
Q- 2	15139110	NP510
Q- 5,6,11,12,15,19 20, 21, 22	15129115	2SC1815-Y
Q- 7,8, 9, 10,14	15139103	2SK30ATM-GR
D- 1,2,4,5,6,7	15019103	1S2473
D- 3	15019625	1S2453 zener
C- 2	13569117T0	CQ09S1H222G-V
C- 4, 5, 6, 7	13569121T0	CQ09S1H471G-V
R- 104 thermistor	15229908	SDT-1000

CRB 1/4 PX 1%
CRB 1/4 PX 0.1%

polystyrene
bi-polar
tantalum





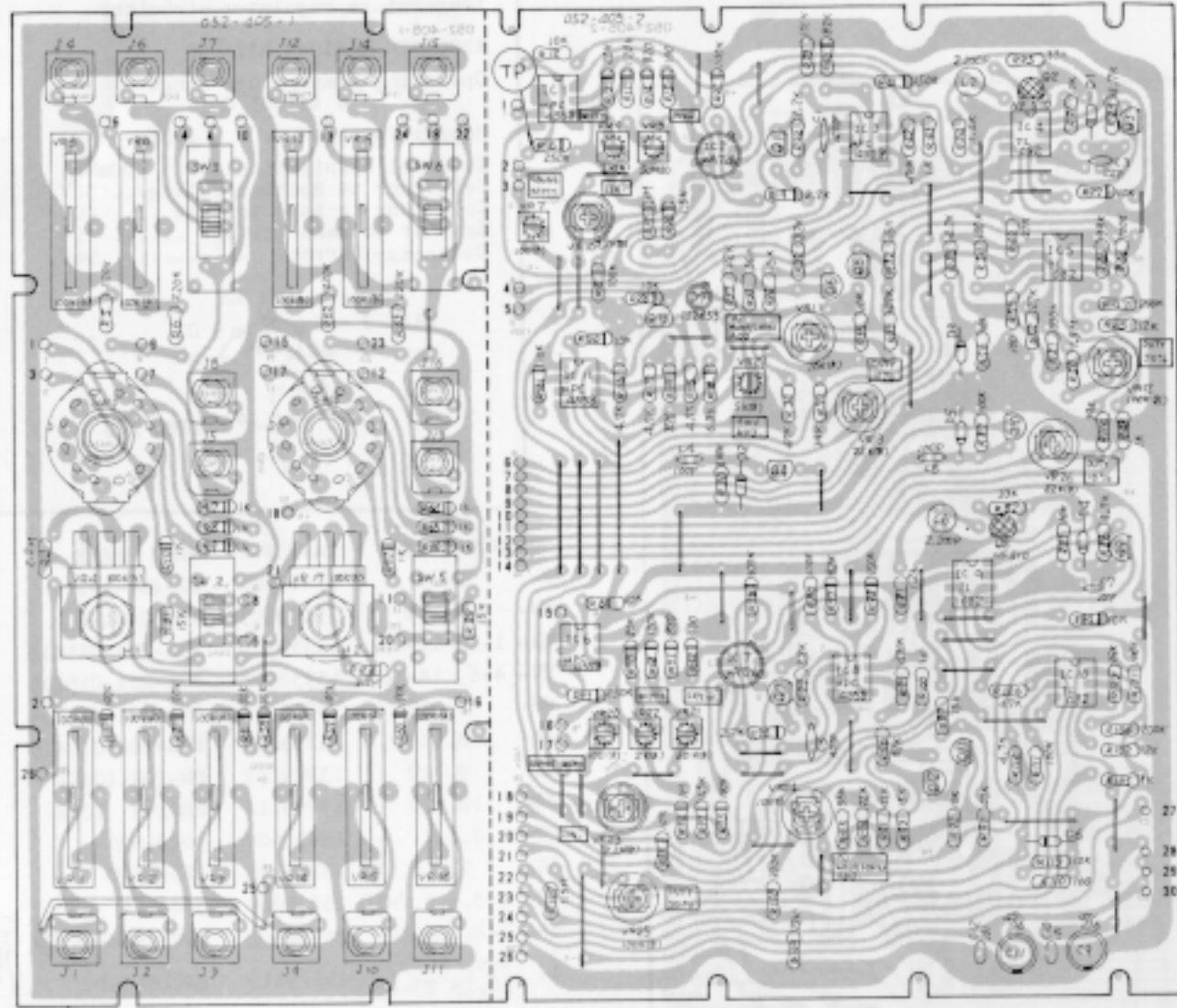
OP9102-030 (P/N 7910203000)
(pcb 052-405-1)

M-112

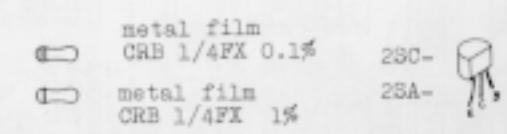
OP9102-040 (Part number 7910204000)
(pcb 052-405-2)

VCO output: 1k, 10V p-p
Input: 50k

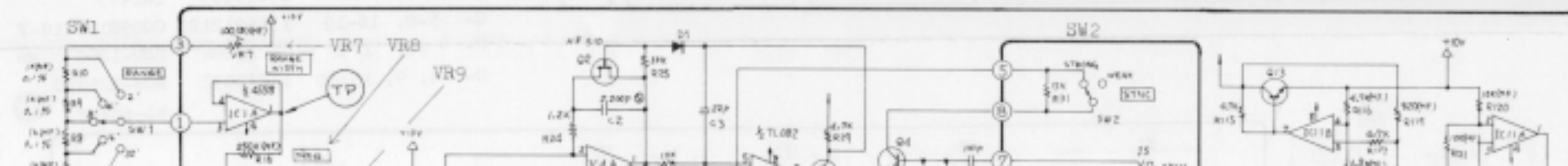
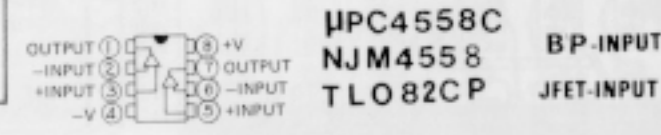
Freq.: 1Hz-30kHz
Control Sens: 1V/oct



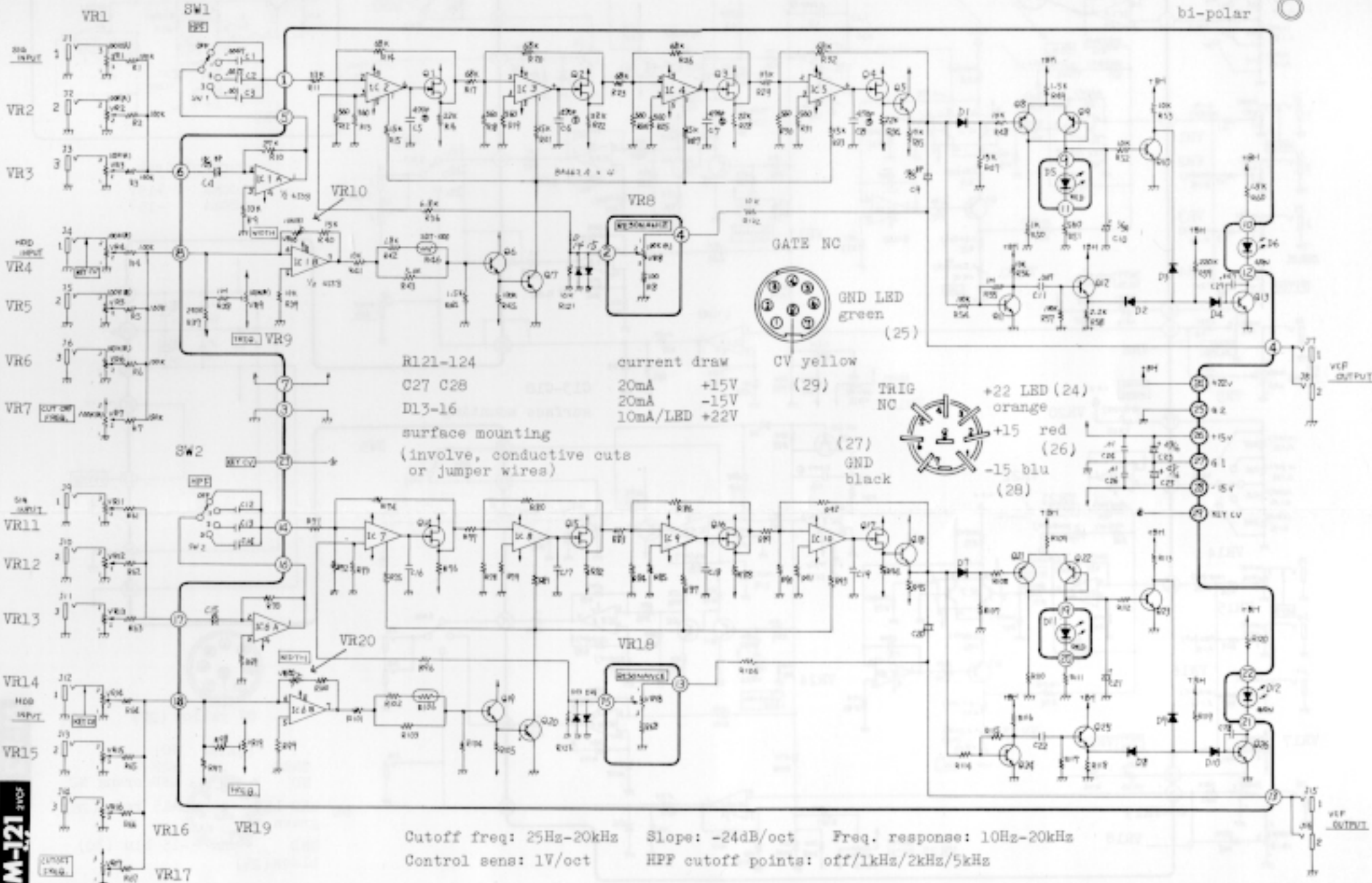
NOMENCLATURE	PART NO.	PART NAME
J- 1-16	13449402	SJ-409-1-2
SW- 1, 4	13119401	SRM-1025172
SW- 2, 5	13159103	SSB-02242
SW- 3, 6	13159304	SSB-02335
VR- 1-3, 14-16	13339301	EVA-H04C15A15
VR- 4, 17	13219220	VM10RB10C 100KB
VR- 5,6,18,19	13339304	EVA-H04C15B15
VR- 7, 20	13299501	PN82-2H101H
VR- 8, 21	13299508	PN82-2H503H
VR- 9, 22	13299504	PN82-2H202H
VR- 10,23	13299542	CR19R 2.2KB
VR- 11,24	13299114	SR19R 10KB
VR- 12,25	13299117	SR19R 100KB
VR- 13,26	13299115	SR19R 22KB
VR- 27	13299507	PN82-2H502H
H- 1, 2	2219510600	Holder N-106
IC- 1,3,6,8,11	15189105	uPC4558C
IC- 2, 7	15219101	uA726HC
IC- 4,5,9, 10	15189118	TL082
Q- 1,3,5,7,9,11	15119112	2SA1015-Y
Q- 2, 8	15139110	NF510
Q- 4,6,10,12,13	15129115	2SC1815-Y
D- 1,2,3,4,5,6	15019103	182473
D- 7	15019625	182453
C- 2, 6	13569117T0	CQ0981H2220-V polystyrene



TOP VIEW



18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1



R121-124
C27 C28
D13-16
surface mounting
(involve, conductive cuts
or jumper wires)



Cutoff freq: 25Hz-20kHz Slope: -24dB/oct Freq. response: 10Hz-20kHz
Control sens: 1V/oct HPF cutoff points: off/1kHz/2kHz/5kHz

M-121 300F

SYSTEM 100M

OP9103-030(P/N 7910303000)
(pcb 052-407-1)

M-121

OP9103-040 (Part number 791030400)
(pcb 052-407-2)

μA726 M-110 M-112

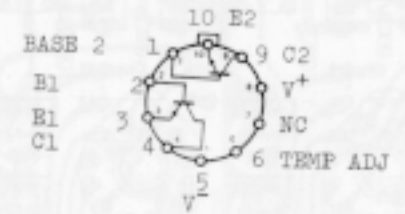
The transistor pair is held at a constant temperature by active temperature regulator circuitry.

ABSOLUTE MAXIMUM RATINGS

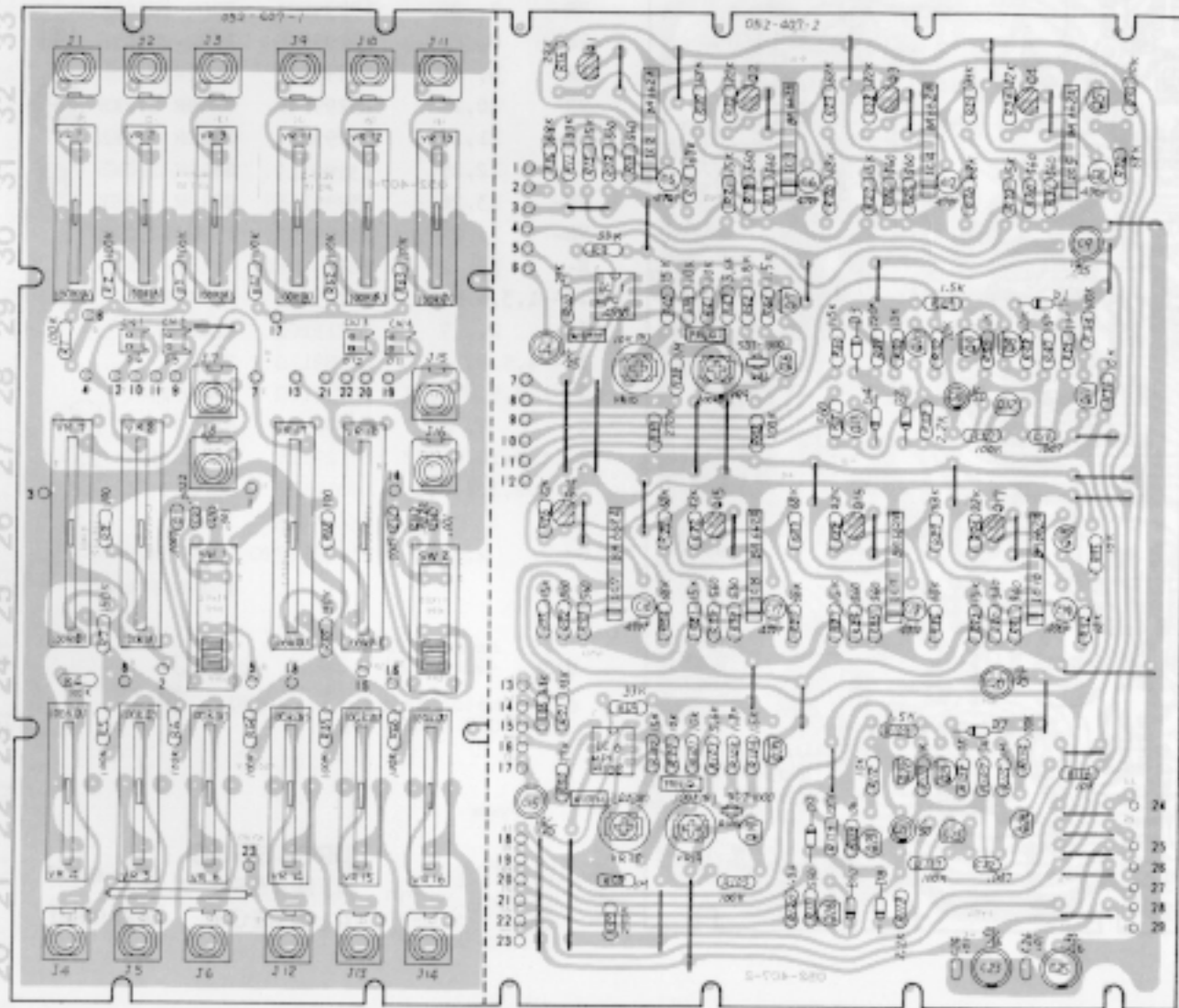
Operating Temperature Range
0°C to +85°C

Supply Voltage . . . ±18V

Internal Dissipation... 500mW
Collector to Emitter Voltage... 30V
Collector to Base Voltage 40V
Emitter to Base Voltage 5V
Collector Current 5mA



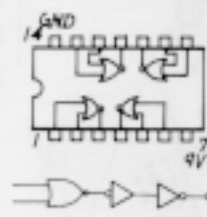
NOMENCLATURE	PART NO.	PART NAME
J- 1-16	13449402	SJ-409-1-2
SW- 1, 2	13159503	SQPR24-12P
VR- 1-3, 11-13	13339301	EVA-H04-C15A15
VR- 4-6, 14-16	13339304	EVA-H04-C15B15
VR- 7, 17	13339402	EVA-TOA-C15B15
VR- 8, 18	13339401	EVA-TOA-C15A15
VR- 9, 19	13299117	SR-19R 100KB
VR- 10, 20	13299114	SR-19R 10KB
CN- 1,2,3,4,	13439502	3024-02C
IC- 1, 6	15189105	uPC4558C
IC- 2,3,4,5,7-10	15229802	BA662-A
Q- 1-4, 14-17	15139103	2SK30ATM-GR
Q- 5,6, 10-13 18,19 23-26	15129115	2SC1815-Y
Q- 7-9, 20-22	15119112	2SA1015-Y
D- 1-4, 7-10	15019103	182473
C- 5-8, 16-19	1356912170	CQ09S1H471G-V
R- 46, 106	15229908	SOT-1000
C- 4, 9, 15,20	13639932	ECB-A25N10



NOMENCLATURE	PART NO.	PART NAME
J- 1-16	13449402	SJ-409-1-2
SW- 1, 2	13159103	SSB-022-42
VR- 1-3, 11-13	13339301	EVA-HO4-C15A15 100KA
VR- 4-6, 14-16	13339304	EVA-HO4-C15B15 100KB
VR- 7, 17	13219220	VM10RB10CK20 100KB
VR- 8, 10, 18, 20	13299117	SR19R 100KB trimmer
VR- 9, 19	13299115	SR19R 22KB
CN- 1-4	13439502	3024-02C
IC- 1, 2	15229803	BA662-B
IC- 3	15189105	uPC4558C
Q- 1, 12	15139103	28K30ATM-GR FBT
Q- 2, 4, 8-11	15129115	28C1815-Y
Q- 3, 5-7	15119112	28A1015-Y
D- 1-4, 7-10	15019103	182473
C- 10mfd/25V	13639932	Bi-polar ECR-A25N (C9)

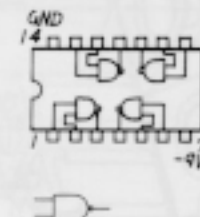
TC4001BP

Quad 2-Input NOR Gate

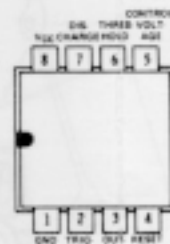


TC4011UBP

Quad 2-Input NAND Gate



NE555 TIMER



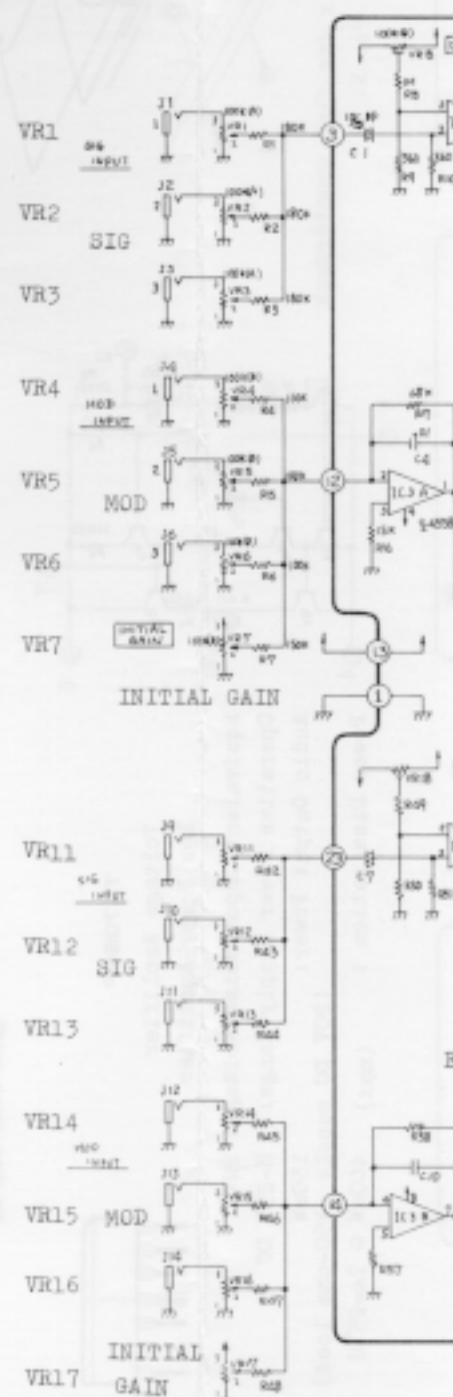
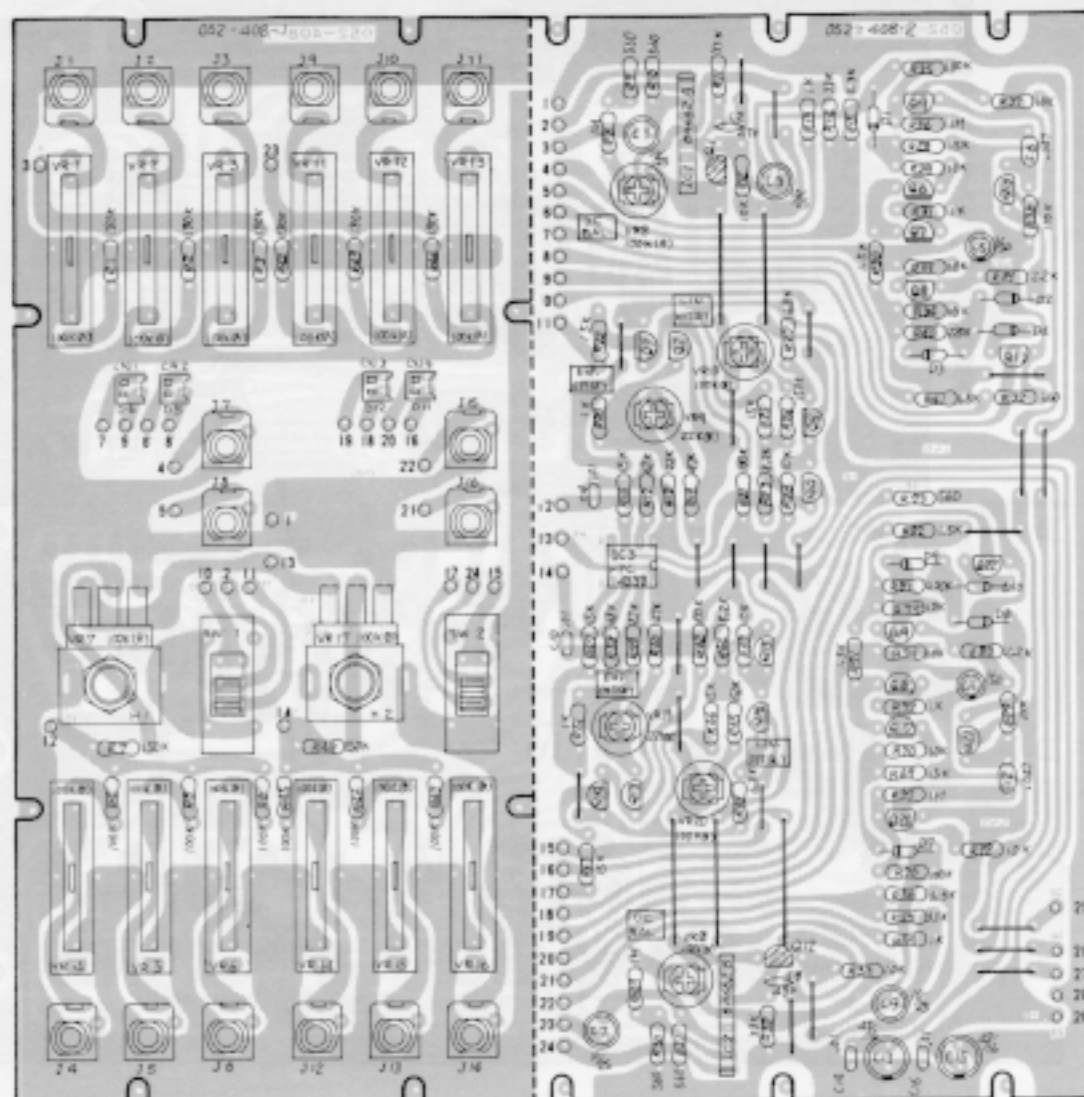
VOC

THRESH (6)
HOLD

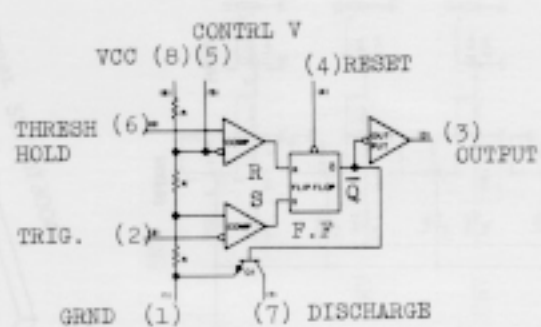
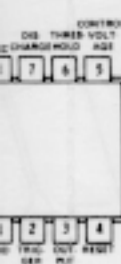
TRIG. (2)

GRND

OP9104-030 (P/N 7910403000) **M-130** OP9104-040 (P/N 7910404000)
(pcb 052-408-1) (pcb 052-408-2)



555 TIMER



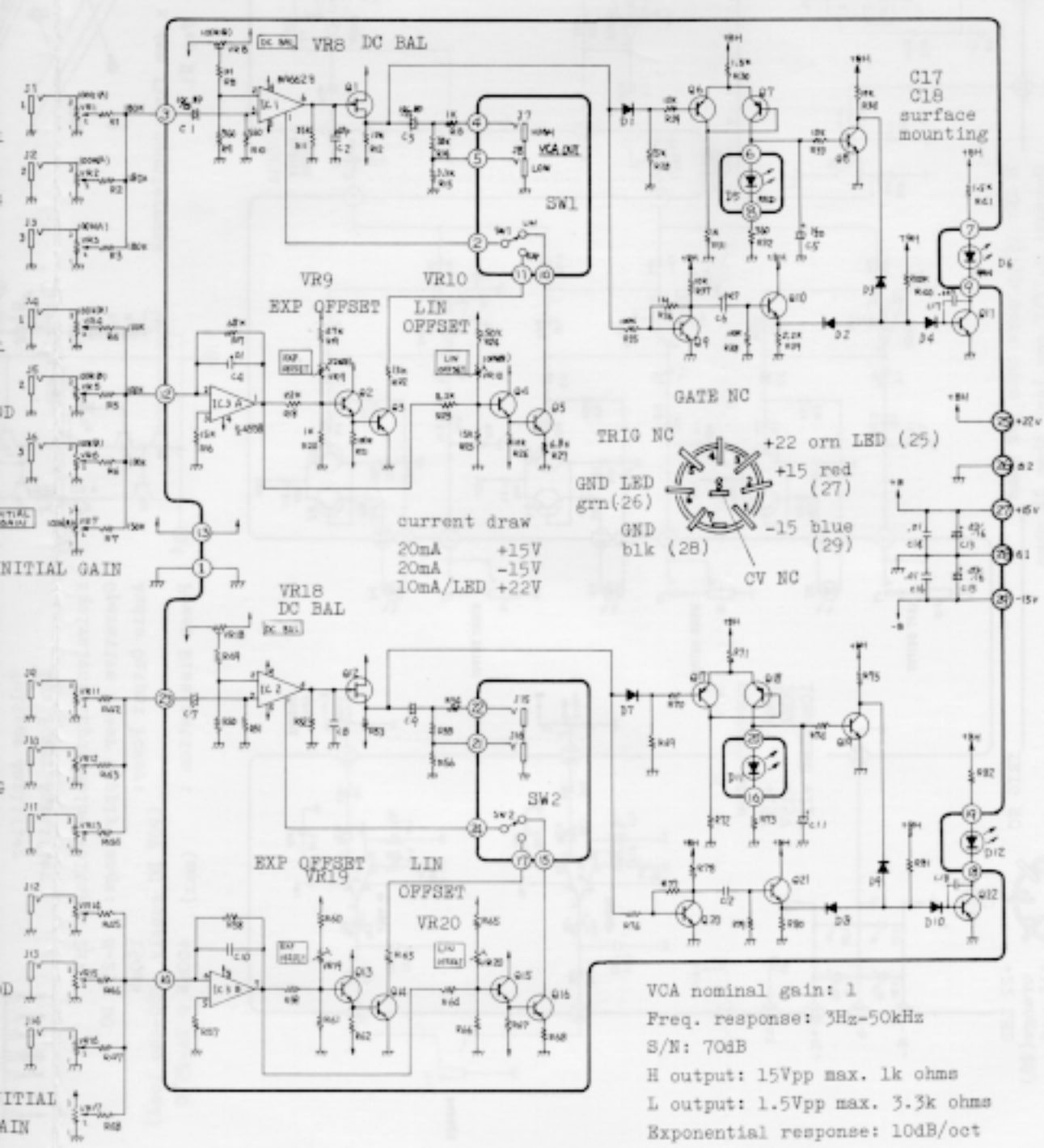
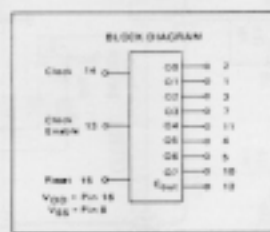
MC14022B OCTAL COUNTER/DIVIDER

TRUTH TABLE


Four stage Johnson octal (Positive Logic) counter with built-in code converter.

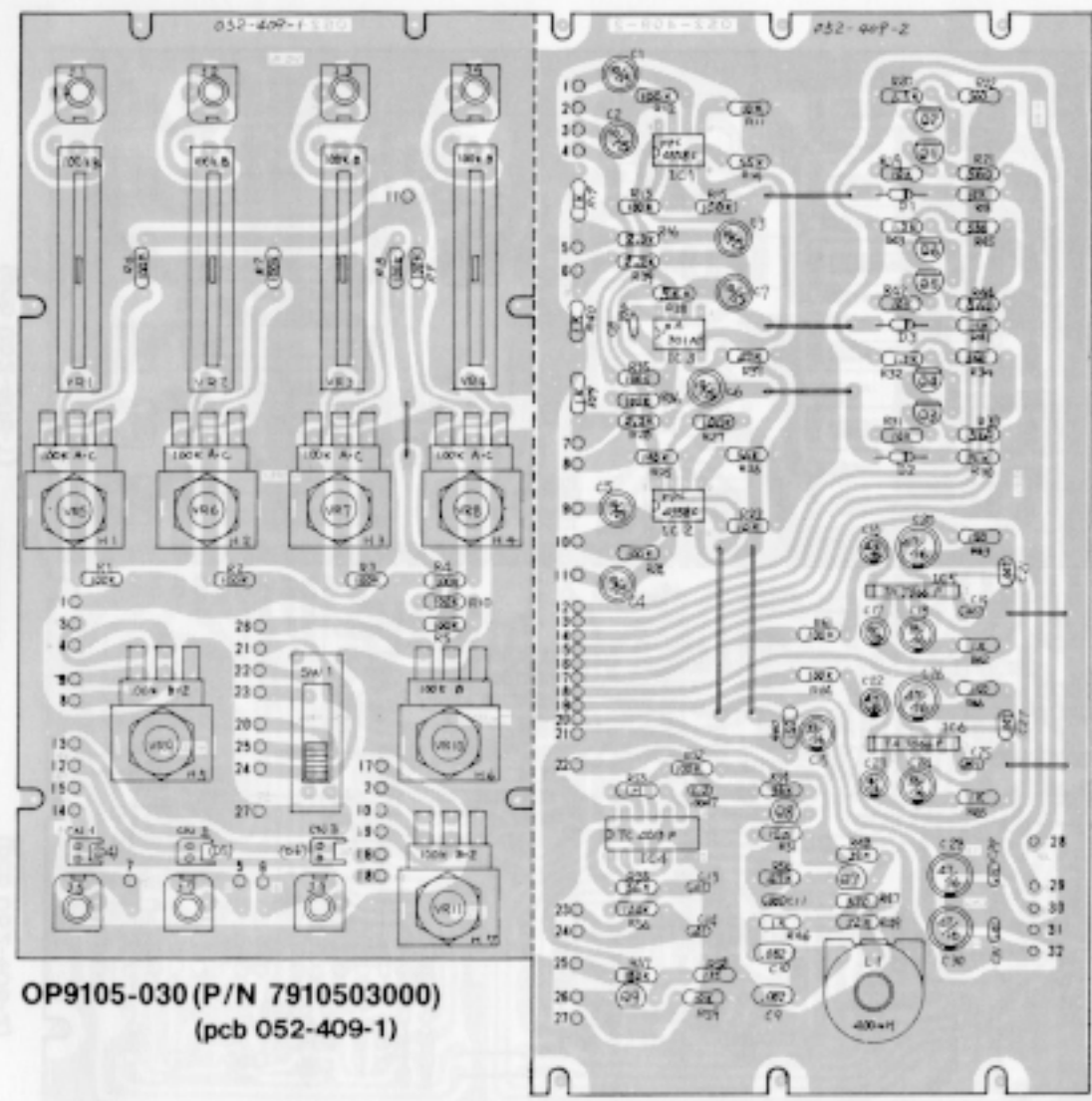
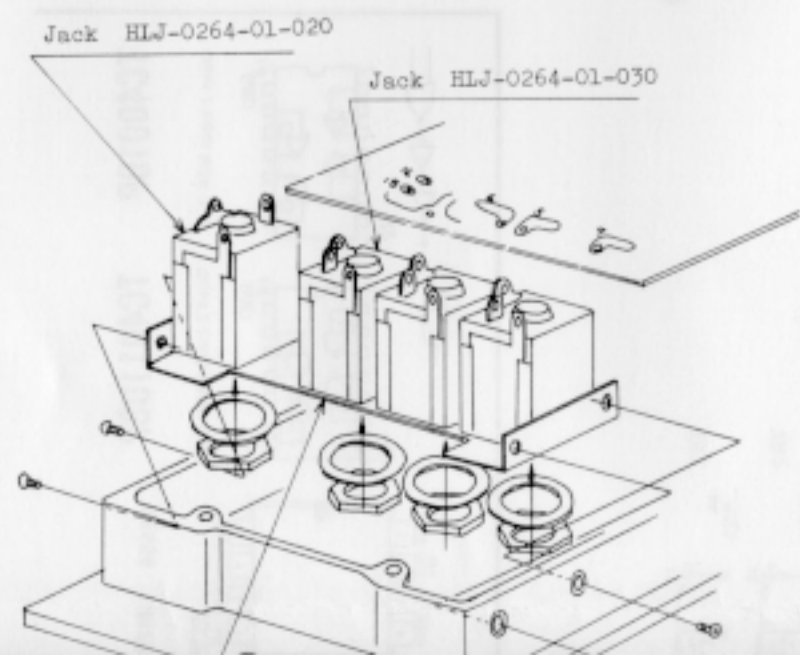
CLK	ENABLE	RESET	OUTPUT
0	X	0	n
X	1	0	n
0	0	0	n+1
1	X	0	n
X	0	0	n+1
X	X	0	n
X	X	1	Q0

X Don't Care
If n < 4 Carry=1
Otherwise = 0



VCA nominal gain: 1
Freq. response: 3Hz-50kHz
S/N: 70dB
H output: 15Vpp max. 1k ohms
L output: 1.5Vpp max. 3.3k ohms
Exponential response: 10dB/oct

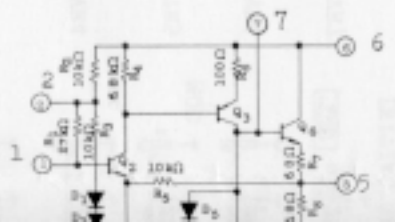
NOMENCLATURE	PART NO.	PART NAME
J- 1-5, 7-9	13449402	SJ-409-1-2
J- 6, 8, 10	13449115	HLJ-0264-01-030
J- 11	13449114	HLJ-0264-01-020
SW- 1	13159503	SQPR24-12P
VR- 1-4	13339402	BVA-TOA-C15B15
VR- 5-8	13219806	GM70R910E K20 100K- A/C
VR- 9, 11	13219807	GM70R910E K20 100KB x 2
VR- 10	13219220	VM10RB10C K20 100KB
H- 8	2219019000	Holder N-190
D- 4-6	15029110	GL-3AR-1
IC- 1, 2	15189105	uPC4558C
IC- 3	15189109	uA301HC
IC- 4	15159105T0	TC4013BP
IC- 5, 6	15199502	TA7066AP
Q- 1-6	15119112	2SA1015-Y
Q- 7-9	15129115	2SC1815-Y
D- 1-3	15019103	182473
L- 1	2244021200	Coil MC4RV 400mH
C- 	13639932T0	ECBA25N10 10mfd/25V



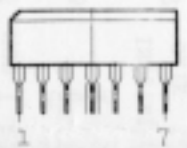
OP9105-030 (P/N 7910503000)
(pcb 052-409-1)

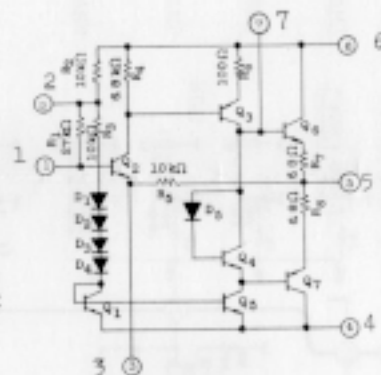
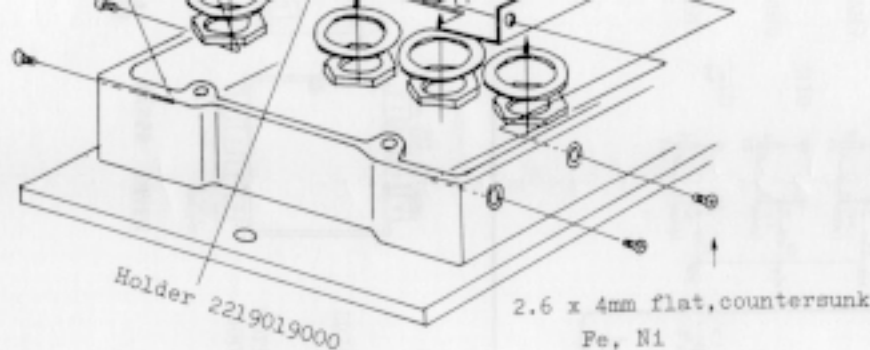
M-131

OP9105-040 (P/N 7910504000)
(pcb 052-409-2)



TA7066P
Voltage Amplifier
Low Power Amplifier
Equivalent Input Noise Voltage: 2uV



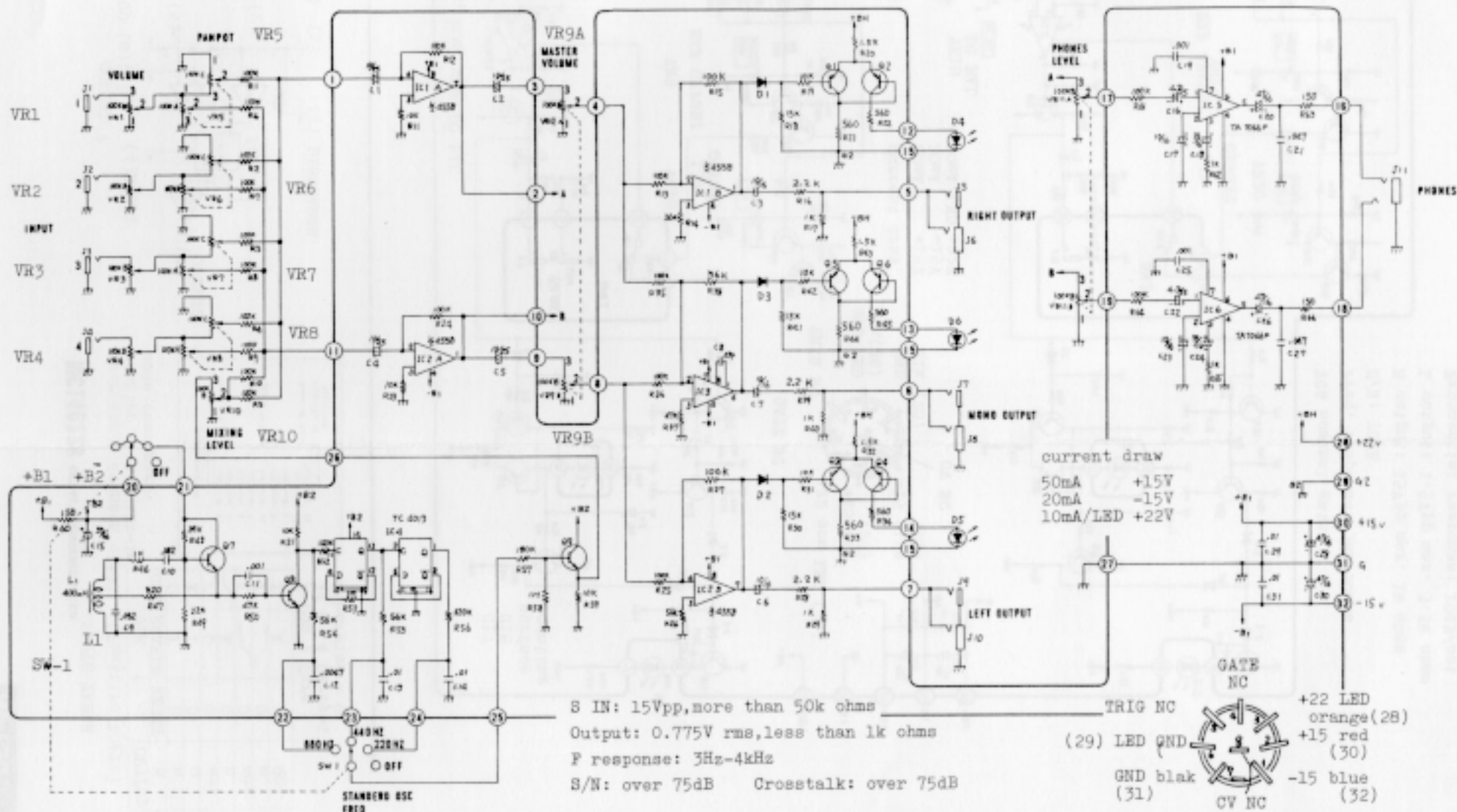
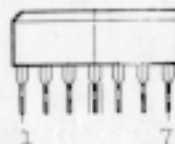


TA7066P


Voltage Amplifier

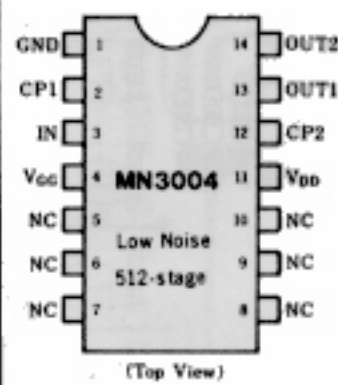
Low Power Amplifier

Equivalent Input Noise Voltage: 2 μ V
Operative Power Supply Range: 8-25V DC
Audio Output Power: 150mW
(20V DC supply 150-ohm load)
Power Dissipation : (max) 400mW @ Ta=25°C



NOMENCLATURE	PART NO.	PART NAME
J- 1-18	13449402	SJ-409-1-2
VR- 1-8	13339304	EVA-H04C15B15
VR- 9, 10	13339402	EVA-T0AC15B15
VR- 11,12	13299544	CR19R 22KB

IC- 1-4	15189105	uPC4558C
Q- 1-4	15119112	2SA1015-Y
D- 1-4	15019103	1S2473
C- 	13639149JO	ECE-A16V47 47/16V

**BBD**

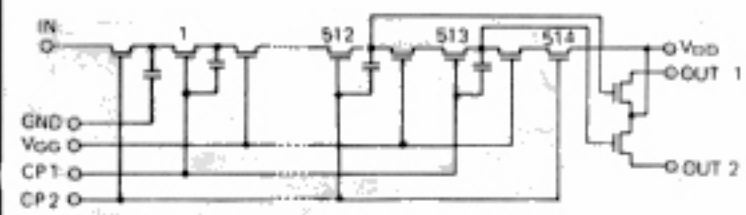
Signal Delay Time
2.56ms-25.6ms

S/N 85dB typ

VDD -15V
VGG -14V

THD 0.4%

+SIG IN
GAIN ADJ ②
GAIN ADJ ③
-SIG IN

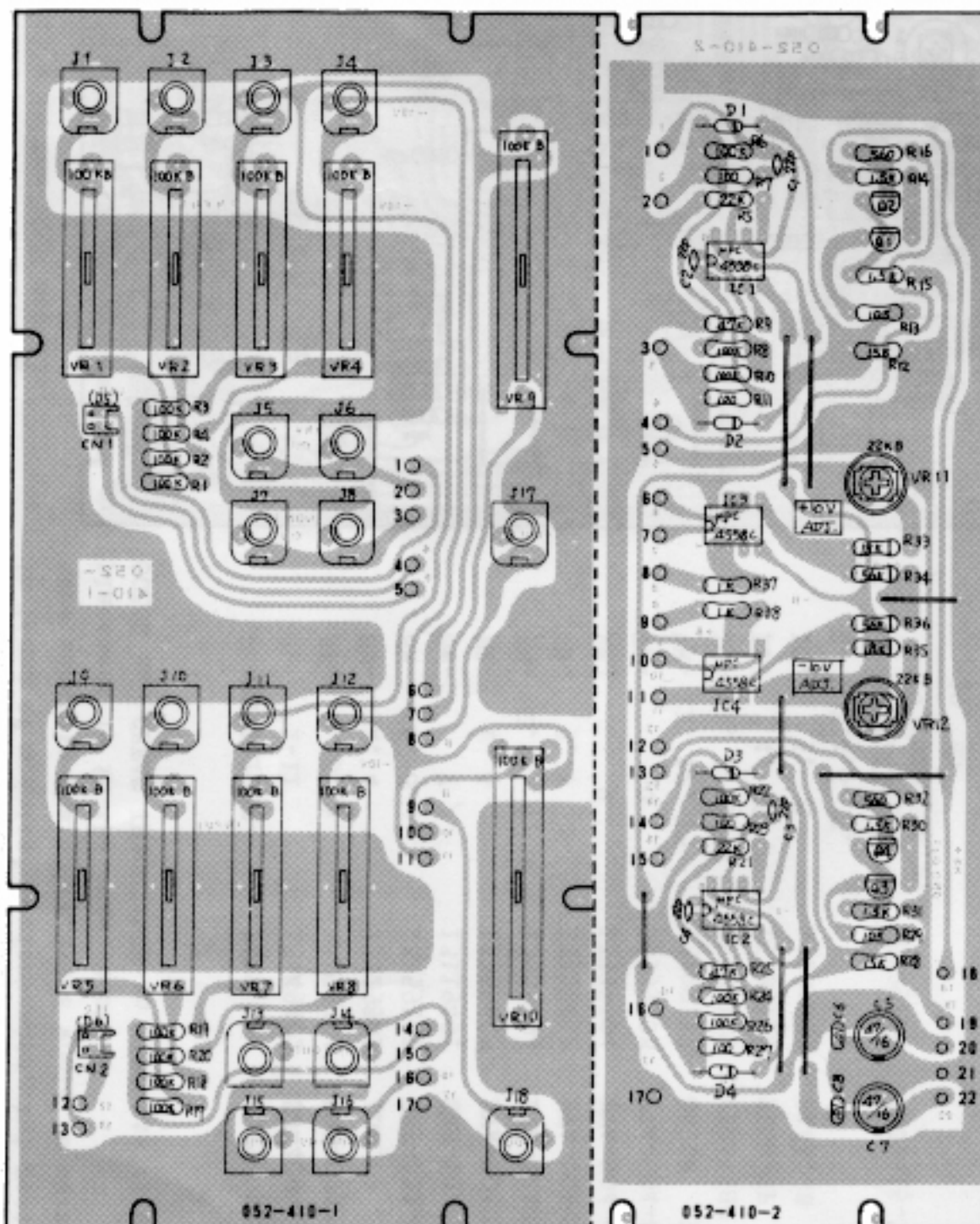


+SIG
GAIN
GAIN
-SIG
BIAS
+OUT

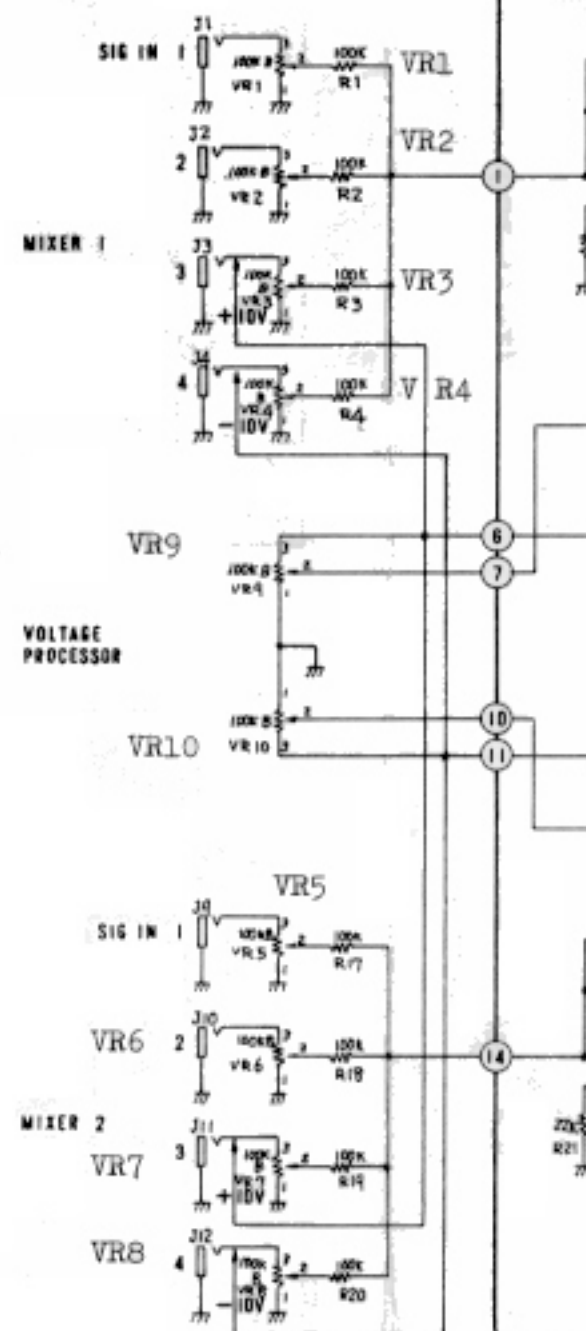
OP9106-030 (P/N 7910603000)
(pcb 052-410-1)

M-132

OP9106-040
(Part Number 7910604000)
(pcb 052-410-2)

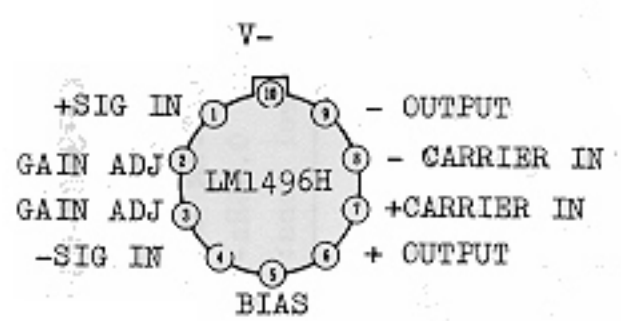


Signal input: $\pm 10V_{pp}$ max. m
Output: $\pm 10V_{pp}$ max. 1k oh
F. response: DC-40kHz



3D

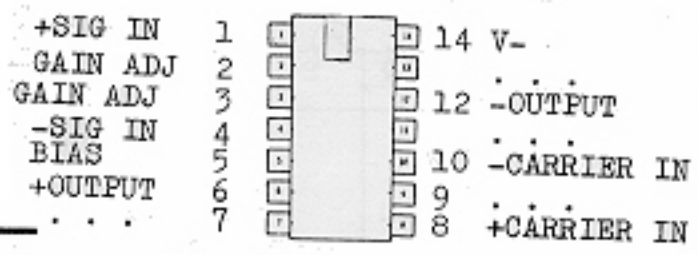
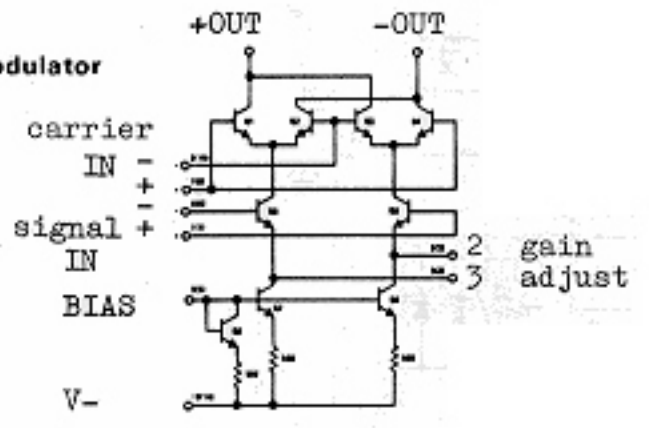
Delay Time
-25.6ms
85dB typ
-15V
-14V
0.4%



(Top View)

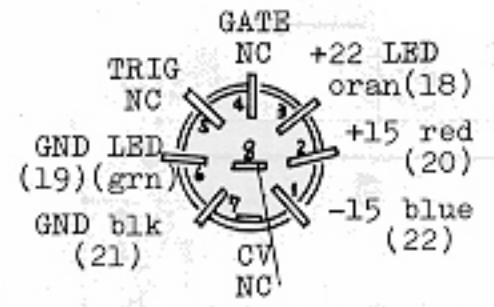
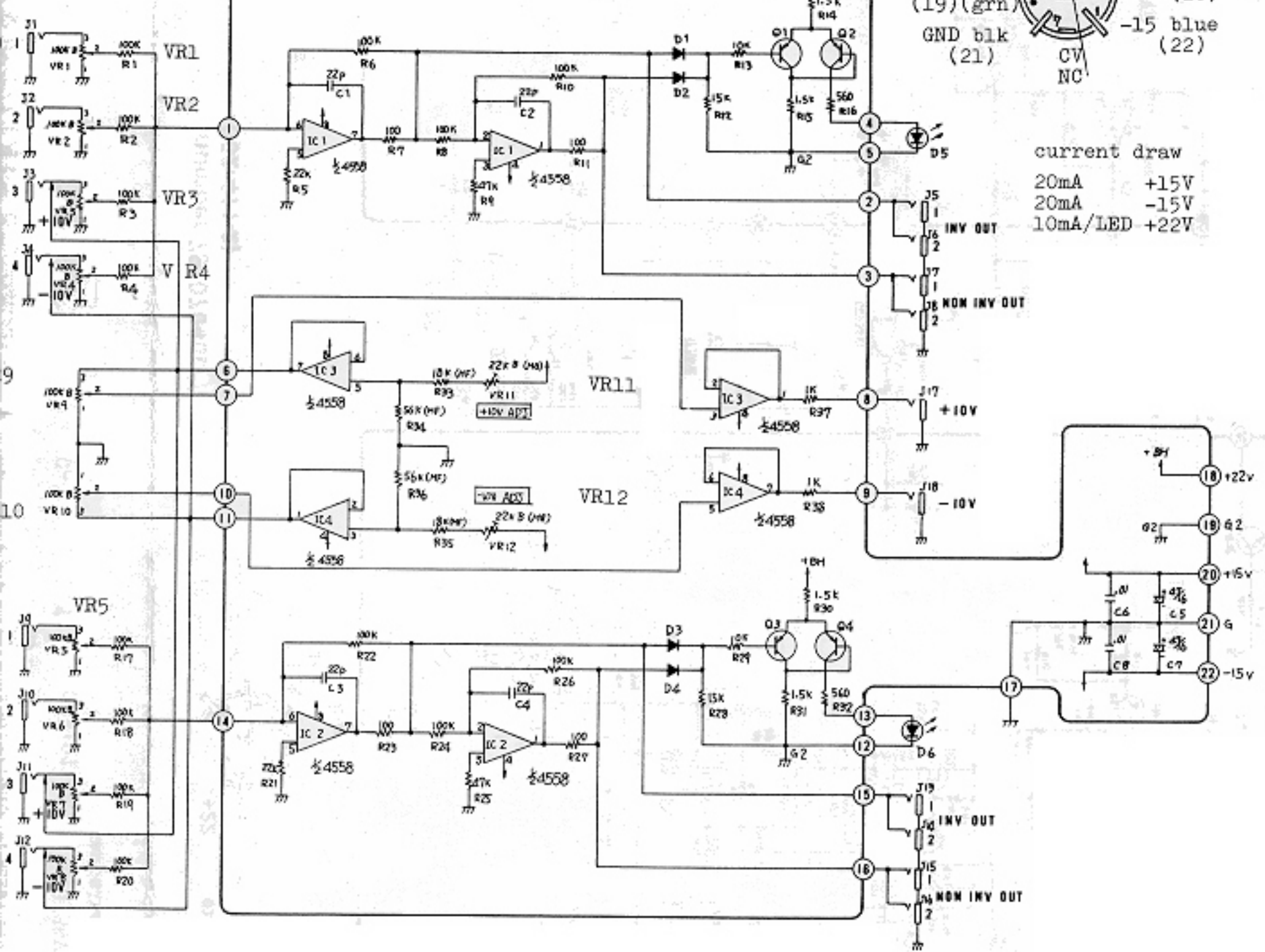
Output voltage is proportional to the product of an input (signal) voltage and a switching (carrier) signal.
Carrier Suppression: 65dB typ. @ 0.5MHz
50dB typ. @ 10MHz

LM1496 balanced modulator-demodulator



LM1496N

Input: +10Vpp max. more than 50k ohms
Output: +10Vpp max. 1k ohms
Response: DC-40kHz
S/N: over 90dB



current draw
20mA +15V
20mA -15V
10mA/LED +22V

OP9107-030 (P/N 7910703000)
(pcb 052-411-1)

M-140

OP9107-040 (Part number 7910704000)
(pcb 052-411-2)

Gate/Trig in: 50k ohms, 3V min.

LFO: 0.05Hz-30Hz

Control sens: 1V/oct

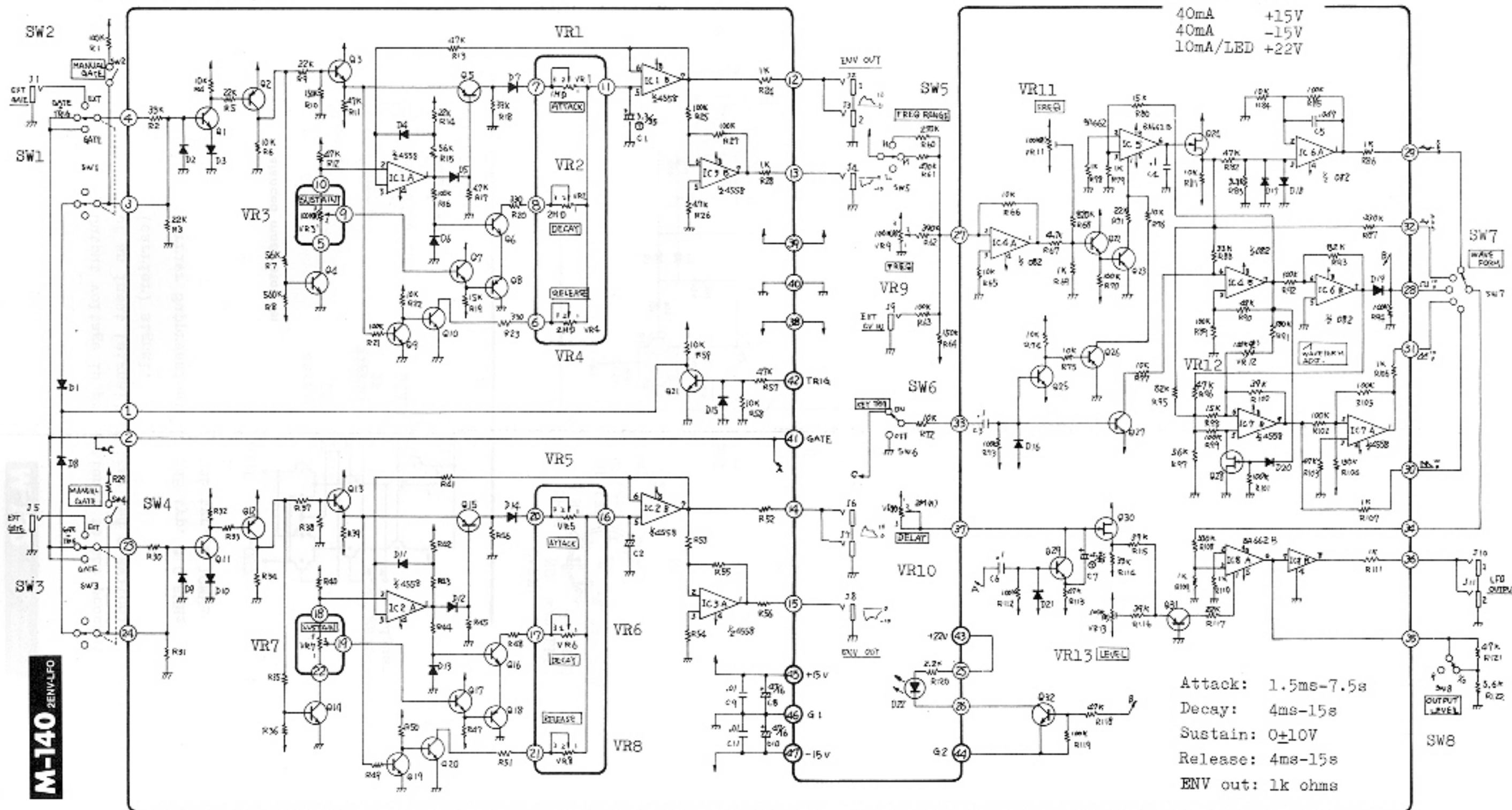
Output: 10Vpp, 1k ohms

Delay time: 0-7s

GATE white(41)
TRIG brn(42) +22 LED orn (43)
Gnd LED grn (44) +15 red (45)
Gnd blk (46) -15 blu(47)

current draw

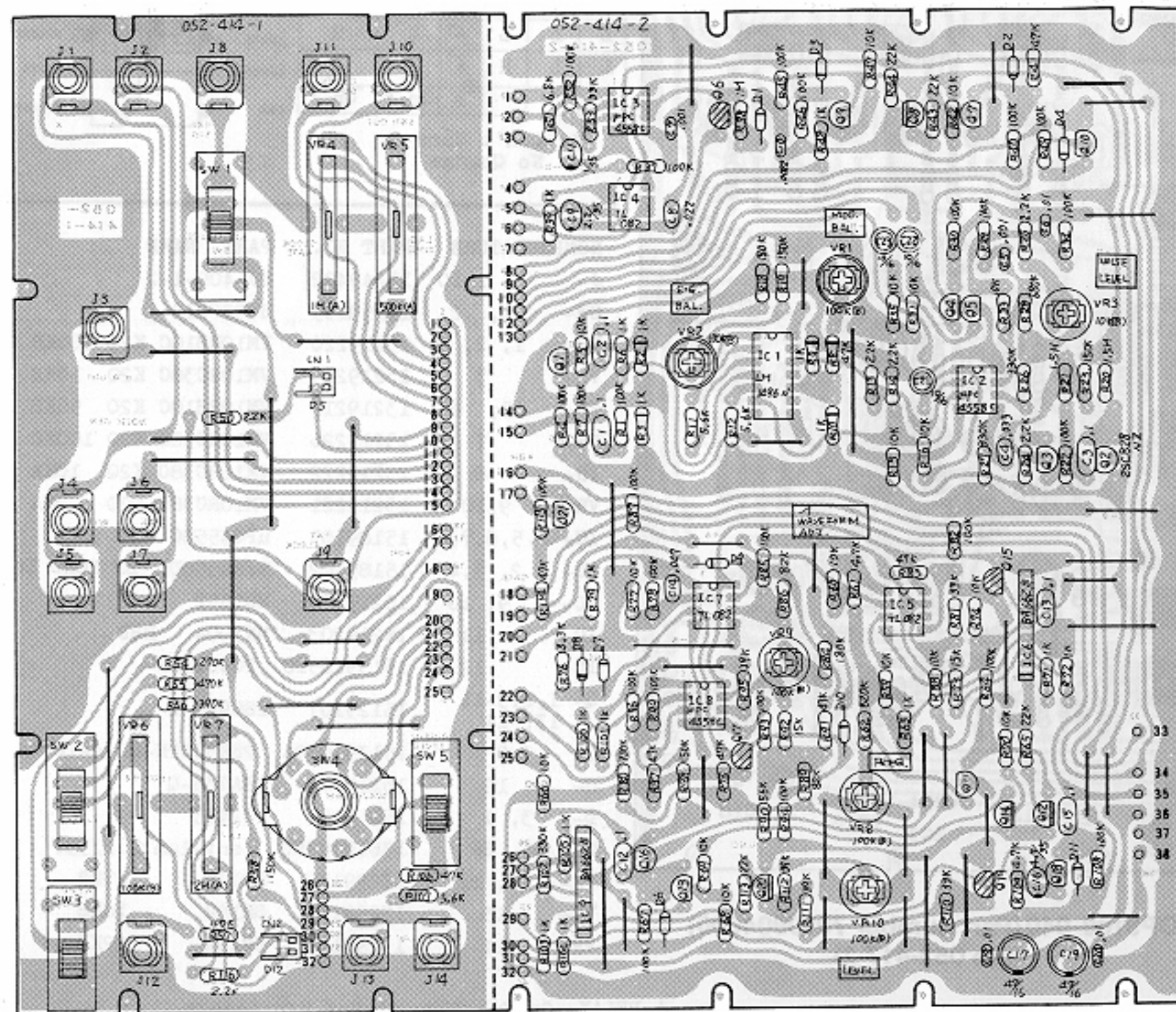
40mA +15V
40mA -15V
10mA/LED +22V





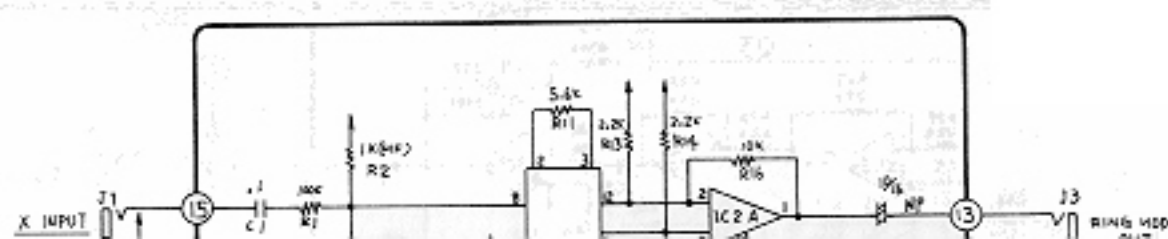
OP9108-030 (P/N 7910803000)
(pcb 052-414-1)

M-150

OP9108-040 (Part number 7910804000)
(pcb 052-414-2)

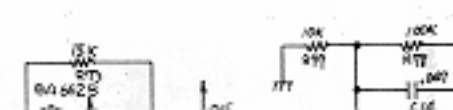


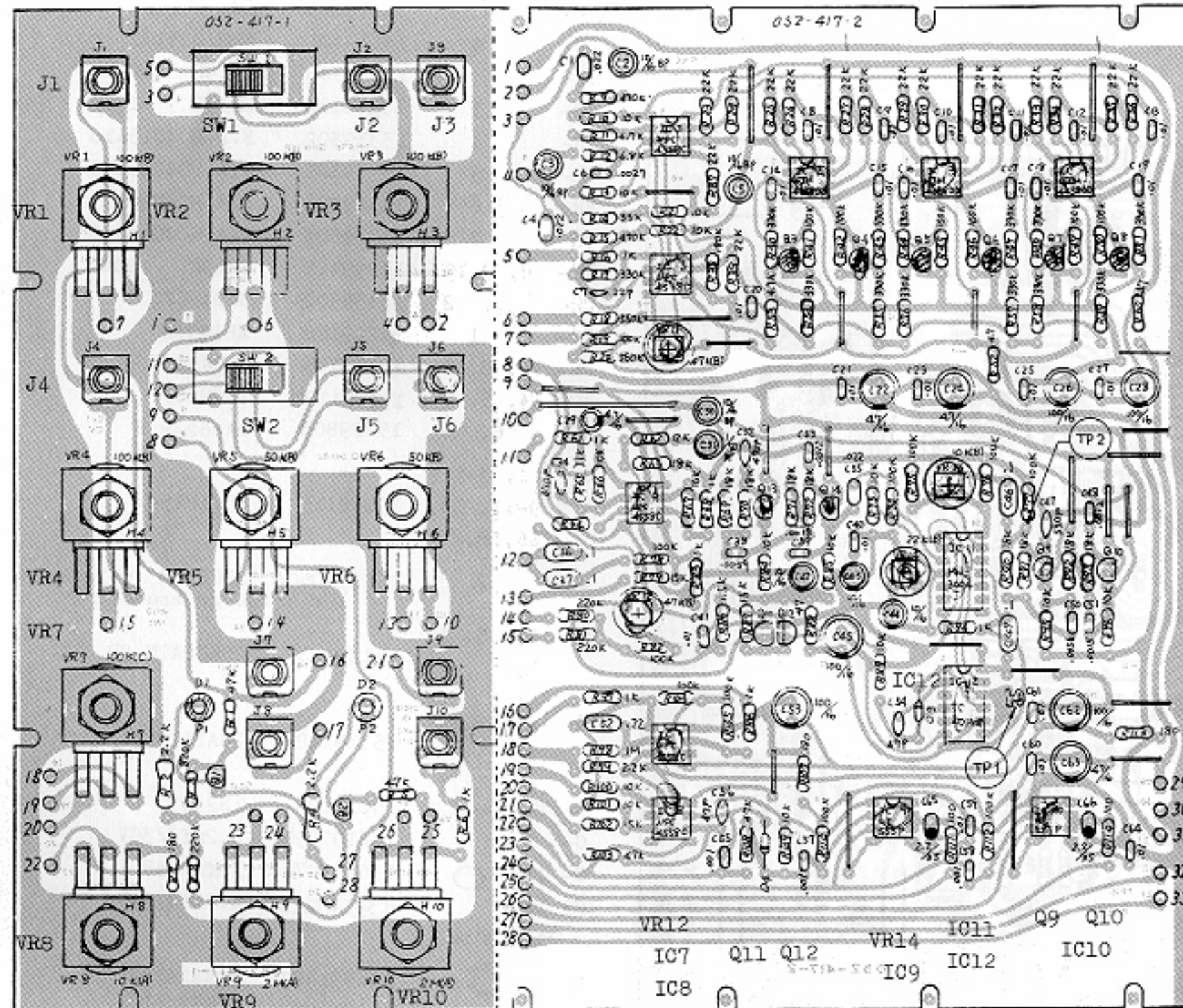
NOMENCLATURE	PART NO.	PART NAME
J- 1-14	13449402	SJ-409-1-2
SW- 1, 2	13159304	SSB-02335
SW- 3, 5	13159103	SSB-02242
SW- 4	13119401	SRM1025172
VR- 1, 2	13299546	CR19R 100KB
VR- 3	13299114	SR19R 10KB
VR- 4	13339302	EVA-H04C15A16
VR- 5	13339305	EVA-H04C15A55
VR- 6	13339304	EVA-H04C15B15
VR- 7	13339303	EVA-H04C15A26
VR- 8, 9, 10	13299117	SR19R 100KB
CN- 1, 2	13439502	3024-02C
IC- 1	15219106	LML496N
IC- 2, 3, 8	15189105	uPC4558C
IC- 4, 5, 7	15189118	TL082CP
IC- 6, 9	15229803	BA662-B
Q- 1, 3-5, 7 9-11, 13, 16, 18, 21	15129115	2SC1815-Y
Q- 2	151291050A	2SC828R selected for noise generator
Q- 6, 15, 17 19	15139103	2SK30ATM-GR
Q- 8, 12, 14 20	15119112	2SA1015-Y
D- 1-4, 6-11	15019103	1S2473
C- 9	13619709N0	2.2mfd/35V
C- 11	13619707N0	1mfd/35V
C- 16	13619711N0	4.7mfd/35V tantalum
C- 	13639149J0	ECEA16V47 47mfd/16V
C- 	13639922J0	ECEA16N10 bi-polar



SW2

VR8





OP9109-030 (7910903000)
(pcb 052-417-1)

M-172

OP9109-040 (Part number 7910904000)
(pcb 052-417-2)

PH.SHIFT-200Hz-8kHz/1080°/F resp:20Hz-20kHz
S/N:60dB/In:10V.50kohm/Out:less 1kohm
EXTCV:10V max 50kohm/Out:less than 1kohm

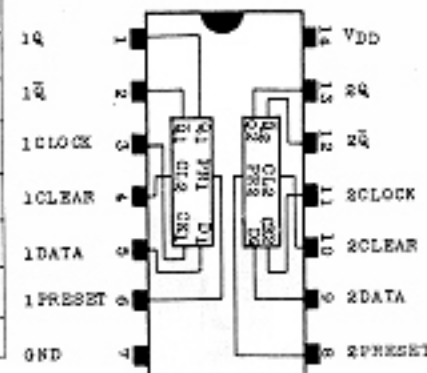
TRUTH TABLE

INPUTS				OUTPUTS	
CL	PR	D	CP	Qn+1	Qn+1
L	H	*	*	H	L
H	L	*	*	L	H
H	H	*	*	L	H
L	L	L	↑	L	H
L	L	H	↑	H	L
L	L	*	↓	Qn	Qn

*: Don't Care
.: No Change

4013B

DUAL TYPE D FLIP-FLOP



NOMENCLATURE	PART NO.	PART NAME
J- 1-10	13449402	BJ-409-1-2
SW- 1, 2	13159103	SSBO2242
VR- 1, 2, 4	13219220	VM10RB10C K20 100KB
VR- 3	13219225	VM10RC38C K20 10KB
VR- 5, 6	13219219	VM10RB10C K20 50KB
VR- 7	13219226	VM10RC38C K20 100KC
VR- 8	13219222	VM10RC38C K20 10KA
VR- 9,10	13219221	VM10RC38C K20 2MA
IC- 1,5,6,7,8	15189105	uPC4558C
IC- 2, 3,4	15189102	NJM4558DD BP MONO Dual
IC- 9, 10	15219109	NE555P
IC- 11	15219203	MN3004 BBD
IC- 12	15159105TO	TC4013BP
Q- 1,2,9-11 13, 14	15129107	28C945-Q
Q- 3-8	151391030A	2SK30ATM-GR selected
Q- 12	15119106	28A733-Q
D- 3, 4	15019103	1S2473
C- 65, 66	13619709NO	tantalum 2.2/35V
VR- 11, 12	13299116	SR19R 47KB
VR- 13	13299114	SR19R 10KB
VR- 14	13299115	SR19R 22KB

A.DELAY-.0m-7ms/30Hz-20kHz/ S/N:60dB/In:10V
50k/Out:less 1k/EXTCV:10Vmax 50kohm

IC1

Q 8

IC4

Q 7

Q 6

IC 3

Q 5

Q 4

IC 2

Q 3

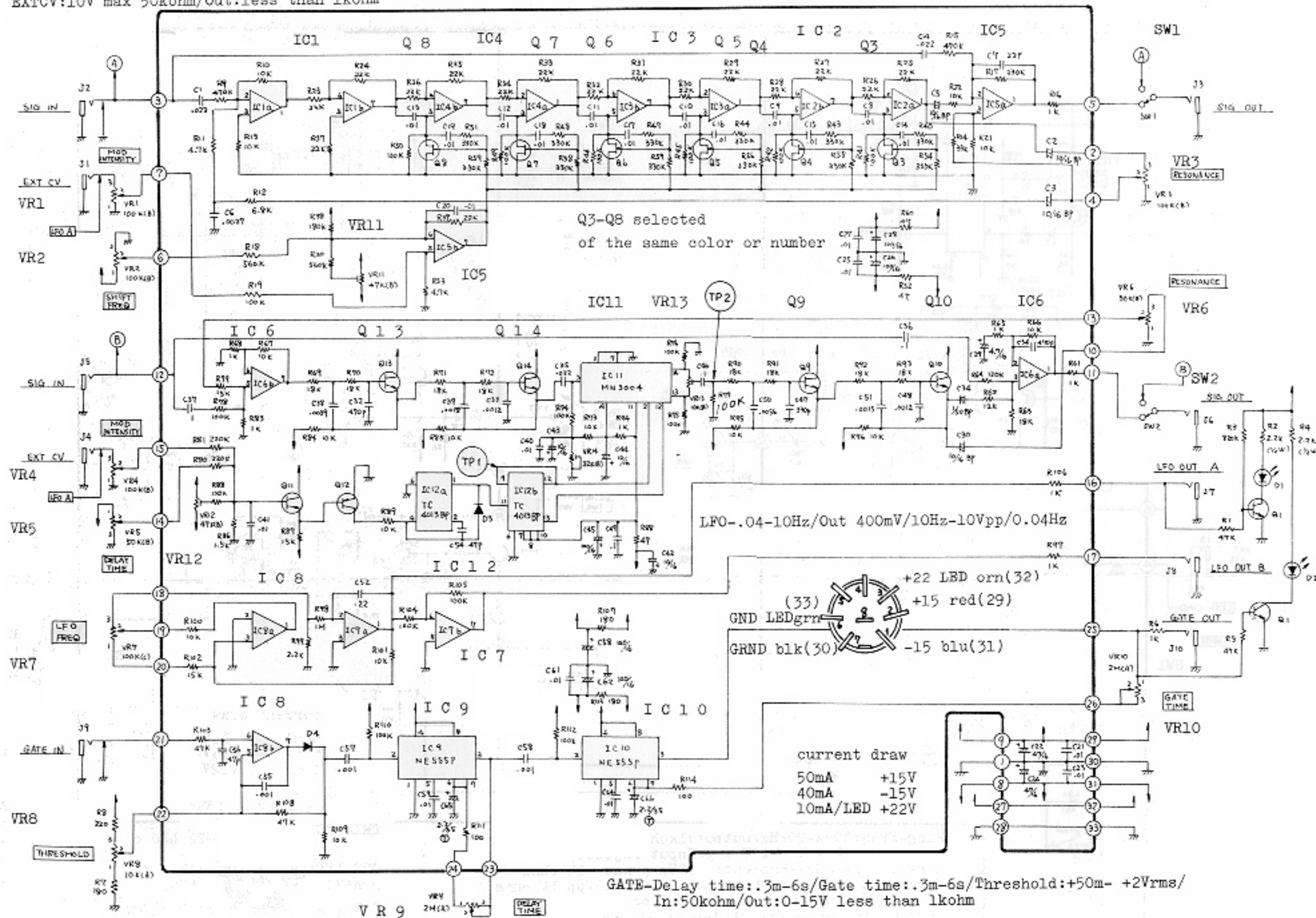
Q 2

IC5

SW1

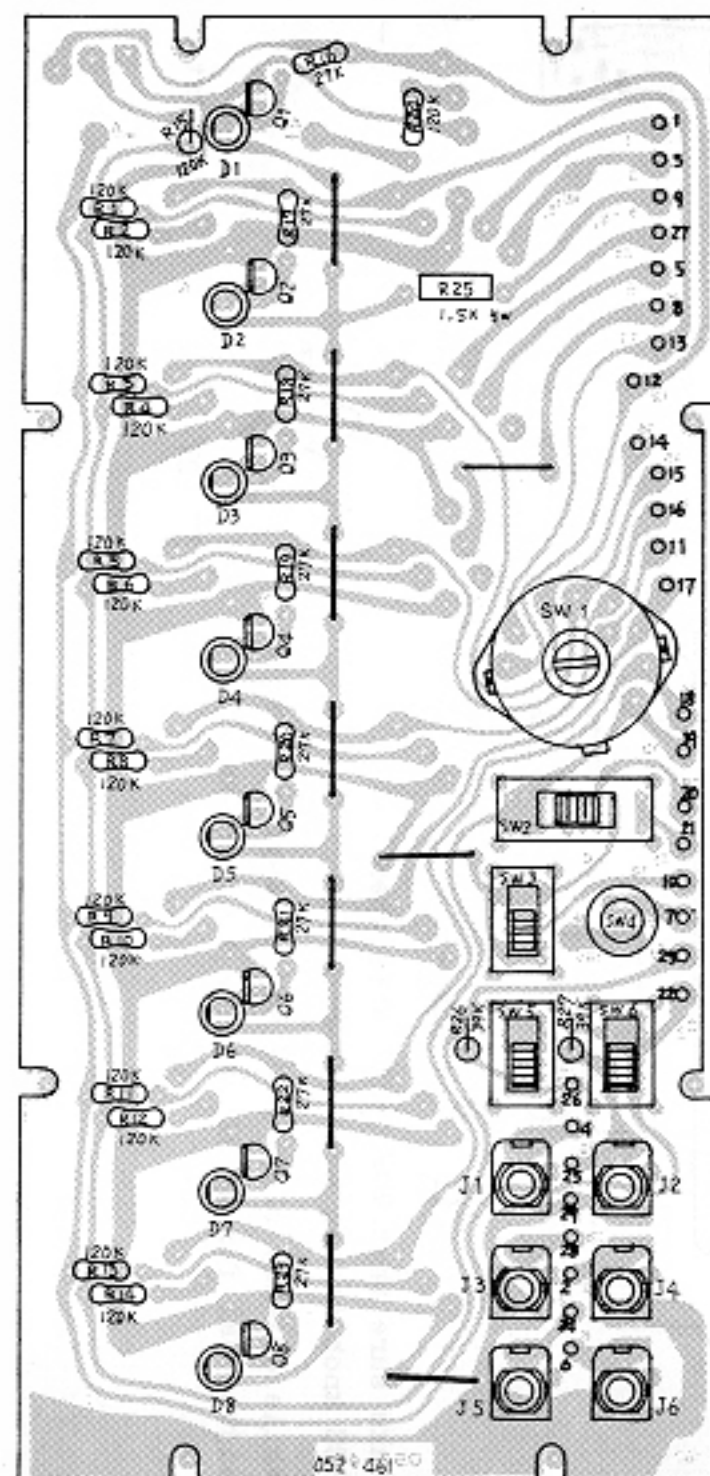
PH.SHIFT-200Hz-8kHz/1080°/F resp:20Hz-20kHz
S/N:60dB/In:10V.50kohm/Out:less 1kohm
EXTCV:10V max 50kohm/Out:less than 1kohm

A.DELAY-.0m-7ms/30Hz-20kHz/ S/N:60dB/In:10V
50k/Out:less 1k/BXTCV:10Vmax 50kohm

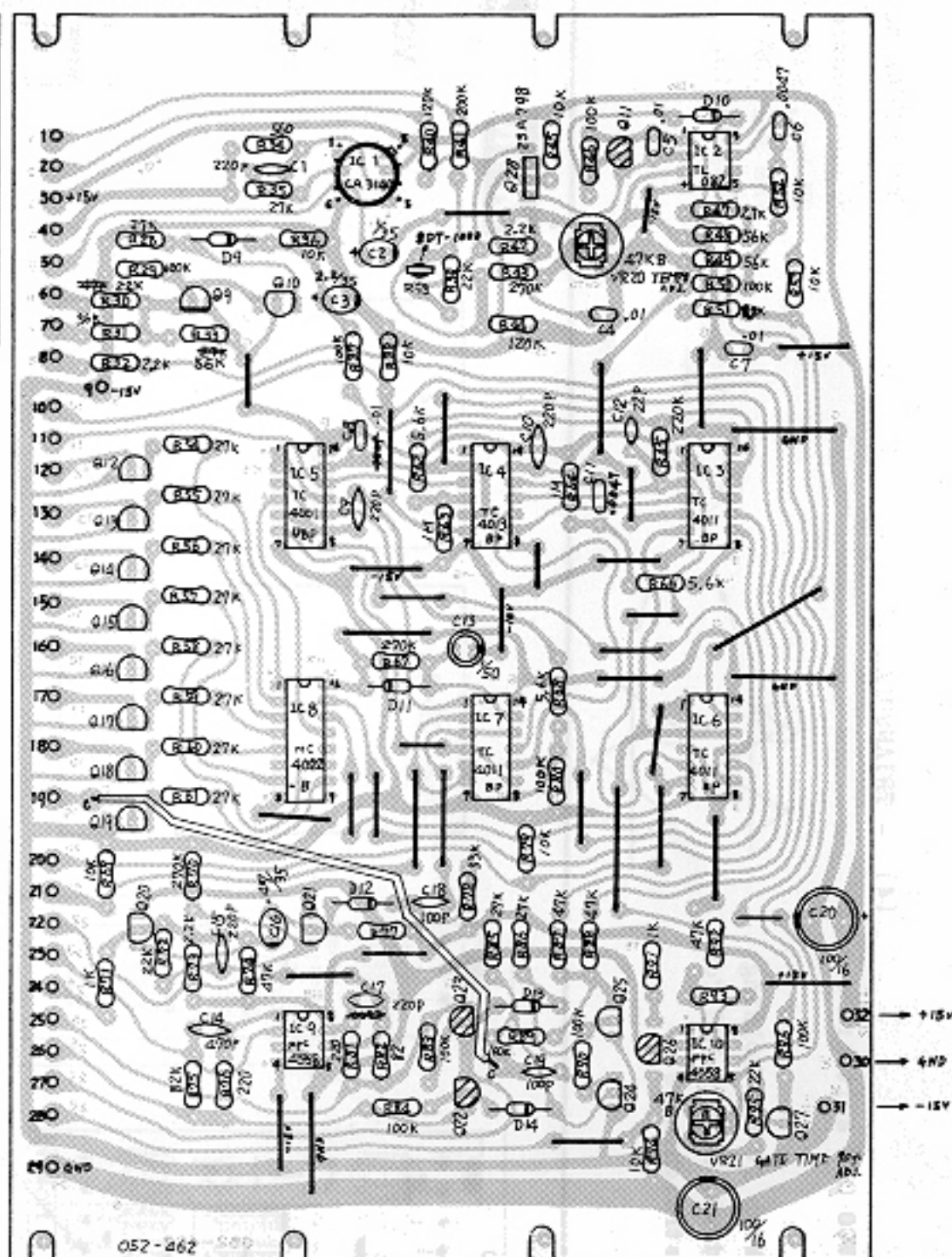


J- 1-6	13449402	SJ-409-1-2	SW- 4	13129901	DS-102 red	IC- 4	15159105T0	TC4013BP	Q- 1-8	15119106	28A733-Q
SW- 1	13119702	SRM1018112	IC- 1	15189121	CA3140T	IC- 5	15159102T0	TC4001UBP	Q- 9	15119108	28A798-G
SW- 2	13159302	SSA04301	IC- 2	15189118	TL082CP	IC- 8	15159107Z0	MC14022B	Q- 10,12-21, 24,25,27	15129107	28C945-Q
SW- 3,5,6	13159102	SSA04202	IC- 3,6,7	15159104T0	TC4011BP	IC- 9,10	15189105	uPC4558C			

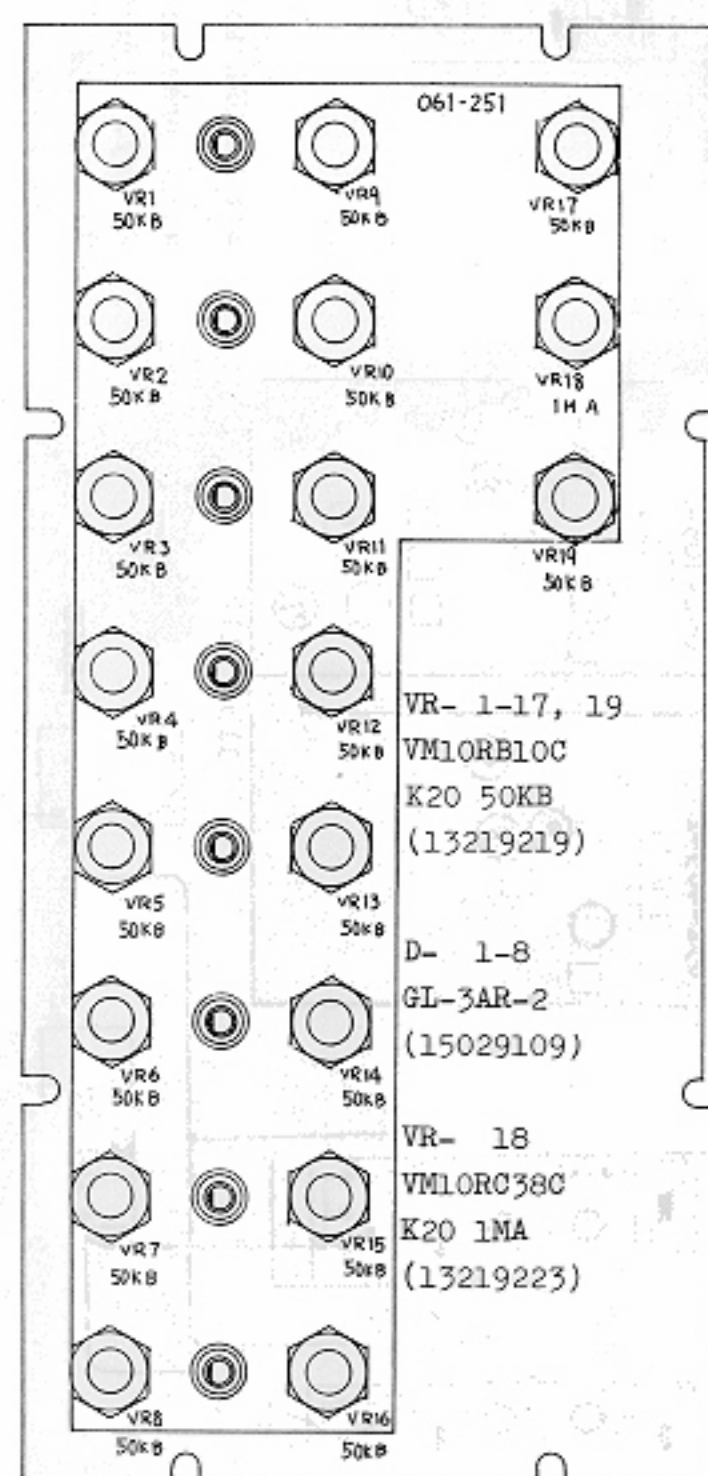
See bottom for remainders.



OP110-030 (P/N 7911003000)
(pcb 052-461)

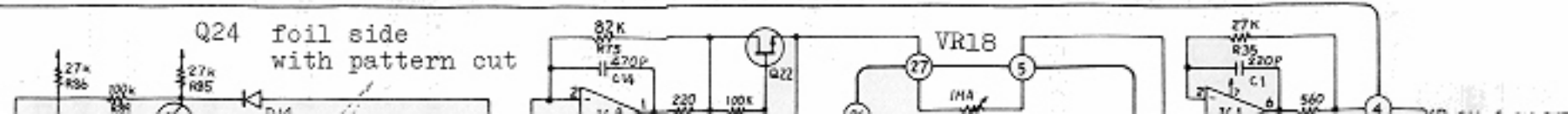


M-182 OP11-040 (Part number 7911004000)
(pcb 052-462)



Tempo: 7s-3ms (0.14Hz-33Hz) PORTAMENTO: 0-10s
Gate time: 10-90%
CV out: 0.3-10V

Gate out: +14V
less than 2k ohms
Tempo in: 0-10V/120k

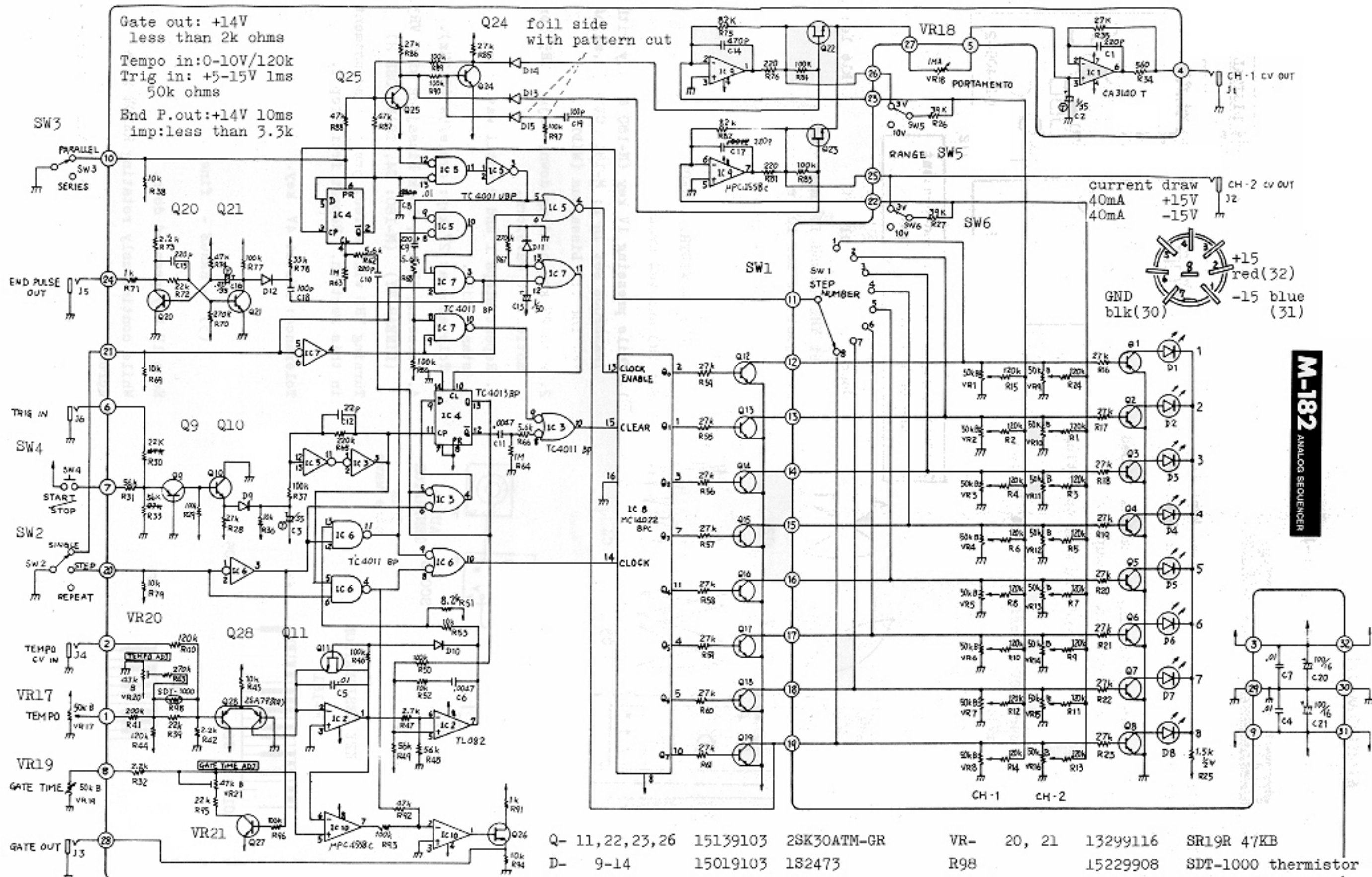


OP110-030 (P/N 7911003000)
(pcb 052-461)

M-182

OP11-040 (Part number 7911004000)
(pcb 052-462)

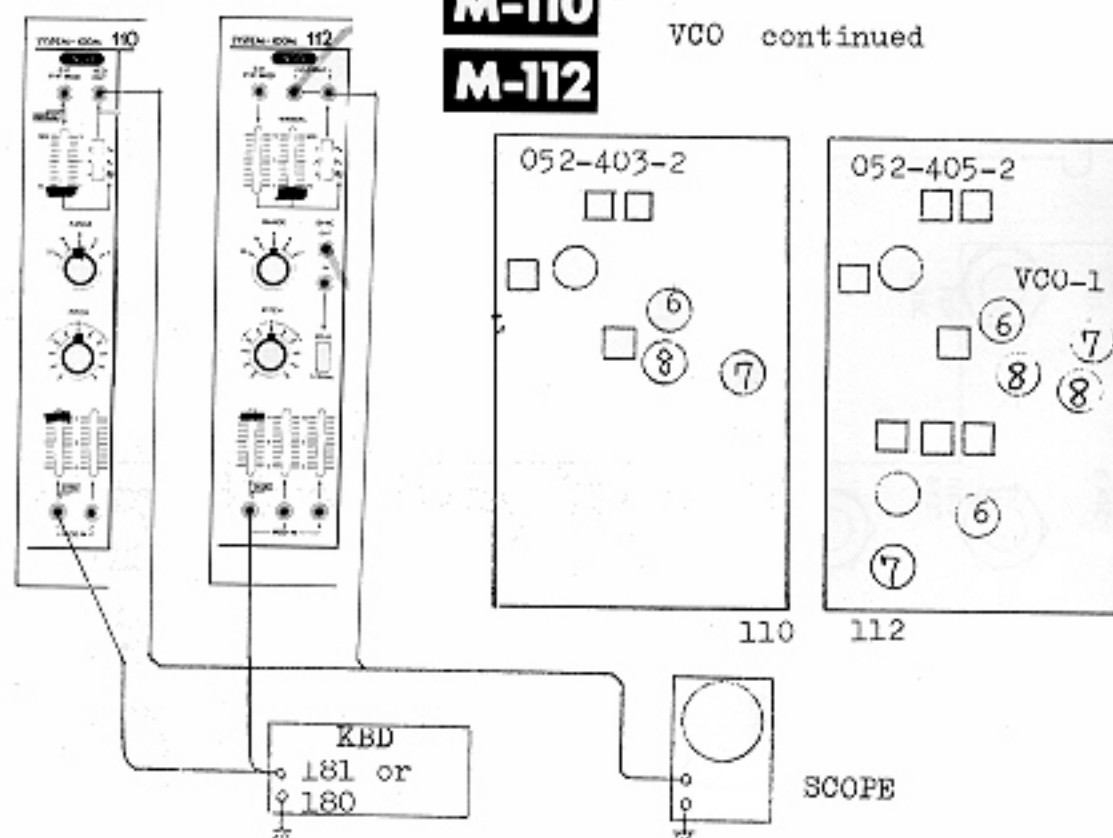
Tempo: 7s-3ms (0.14Hz-33Hz) PORTAMENTO: 0-10s
Gate time: 10-90%
CV out: 0.3-10V



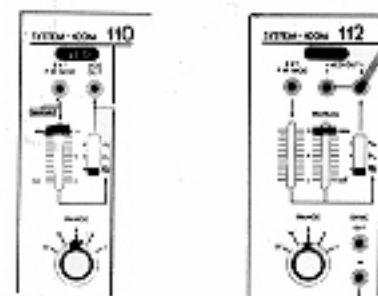
M-110**M-112**

VCO continued

(5) - RECTANGULAR -

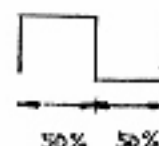


Set OUT switch to .



Set MANUAL to 50% (0).

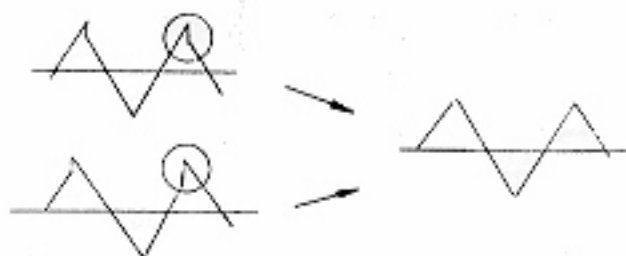
While pressing
2V key, adjust
VR7 for 50%
duty ratio.



(4) - TRIANGULAR -

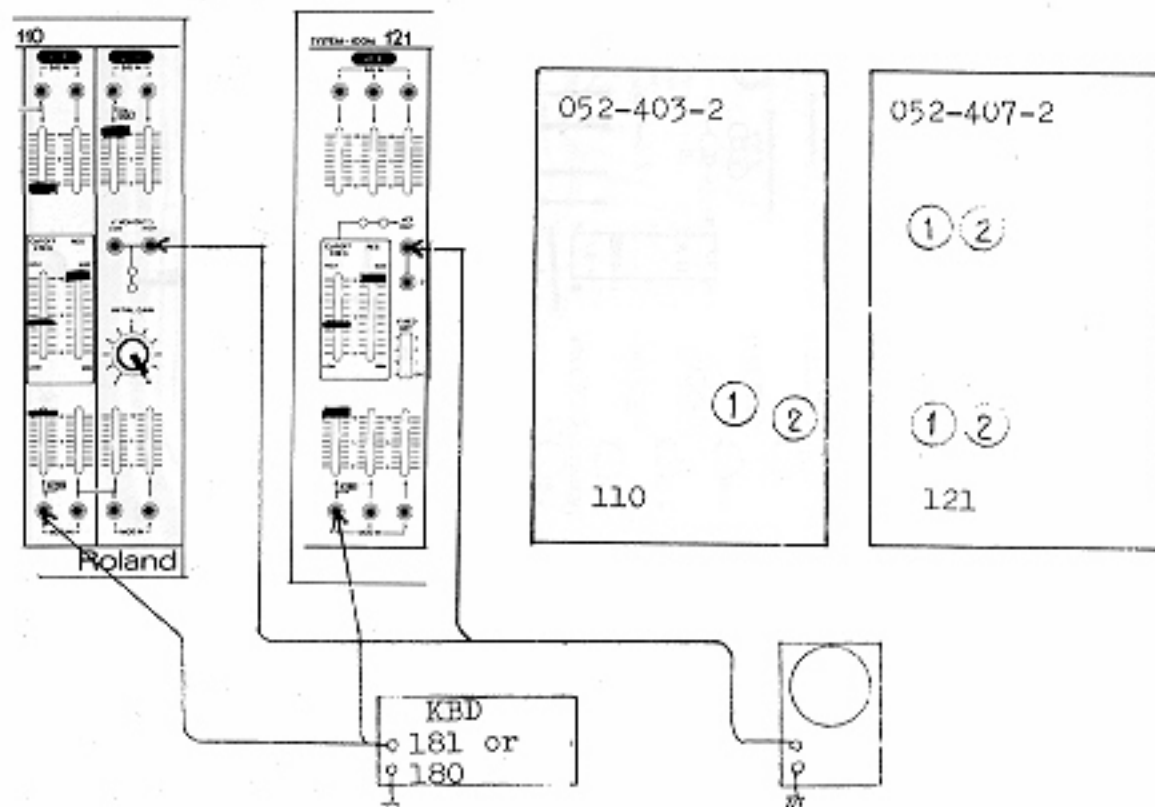
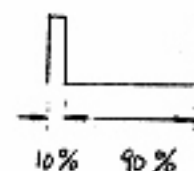
VCO OUT switch: .

With 2V key holding
down, adjust VR6 for
straightness.

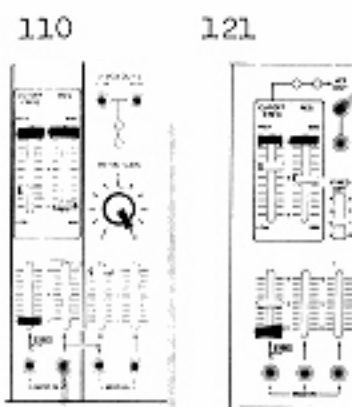


Set MANUAL to MIN (10).

While pressing
2V key, adjust
VR8 for 10%
duty ratio.

**M-110** VCO-VCF-VCA**M-121** 2VCF**VCF**

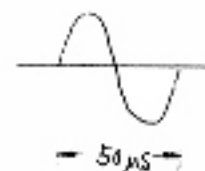
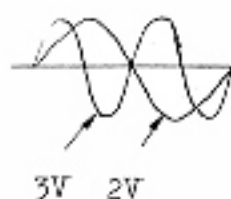
(2) - FREQUENCY -



(1) - WIDTH -

Make sure that VCF oscillates when
RES knob is set around 7-8th line.

While quickly playing 2V and 3V keys alternately,
adjust VR1 for waveforms 1:2 in frequency.



Adjust VR2 for 20kHz (50us).

ADJUSTMENT

For M-180 and M-181, see pp. 16-17.

M-110 VCO-VCF-VCA

M-112 2VCO

The following precautions should be kept in mind before starting adjustment on M-180 and M-181.

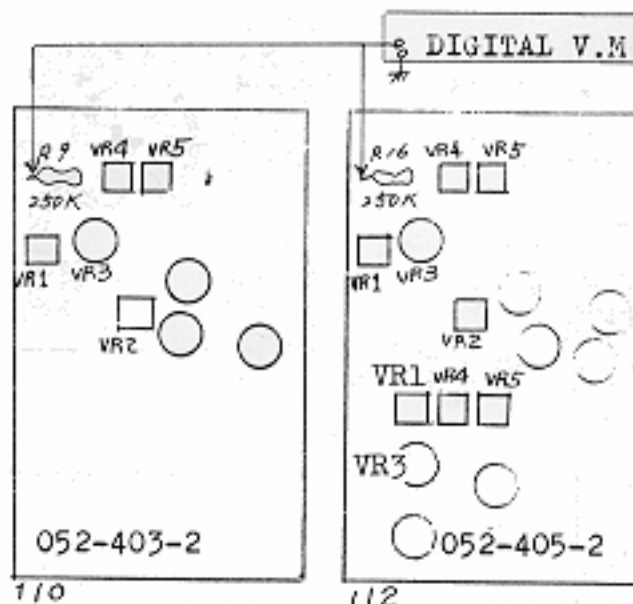
Leave the test and testing equipments turned on for 20-30 minutes as a warmup period.

Keep room at a normal and constant operating temperature.

Check keyboard KCV or reference voltage for 1V/oct ($\pm 1mV$).

VCO

(1) - RANGE - coarse



Trimpot designations are independent of those on circuit diagrams.

Connect digital voltmeter to R9 or R16 lead.

1. Set VR1 around its midpoint.
2. Adjust VR2 for 10V reading.

(2) - WIDTH. FREQUENCY -

Set VR3 and VR4 around the midpoint.

1. While pressing 1V key (M-180 C2 key with TRANSPOSE set in L; M-181 C1 key), adjust VR4 for 1:1 Lissajous (WIDTH).
2. With 2V key holding down, adjust VR5 for motionless waveform.
3. Repeat steps 1 and 2 until waveforms stand still.
Tolerance at 2V key: cycle/5s (0.2Hz).
4. Pressing 5V key, lock Lissajous with VR3. (LINEARITY) (M-180: C4, TRANSPOSE H)

Turning VR3 will affect previous adjustments in this section. Repeat from step 1.

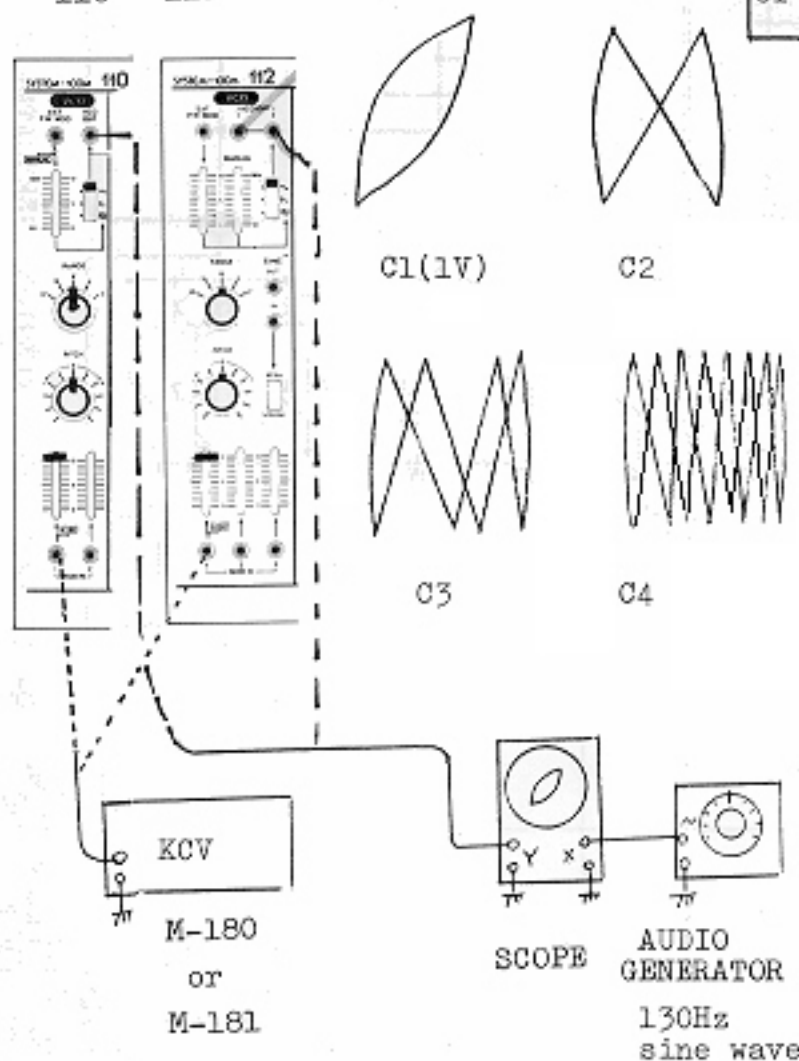
Tolerance: 1Hz at 4V key.

(3) - RANGE - fine

Keep 1V key pressed down.

While continuously rotating RANGE knob across full travel range, adjust VR1 for the least detune at every RANGE setting.

110 112



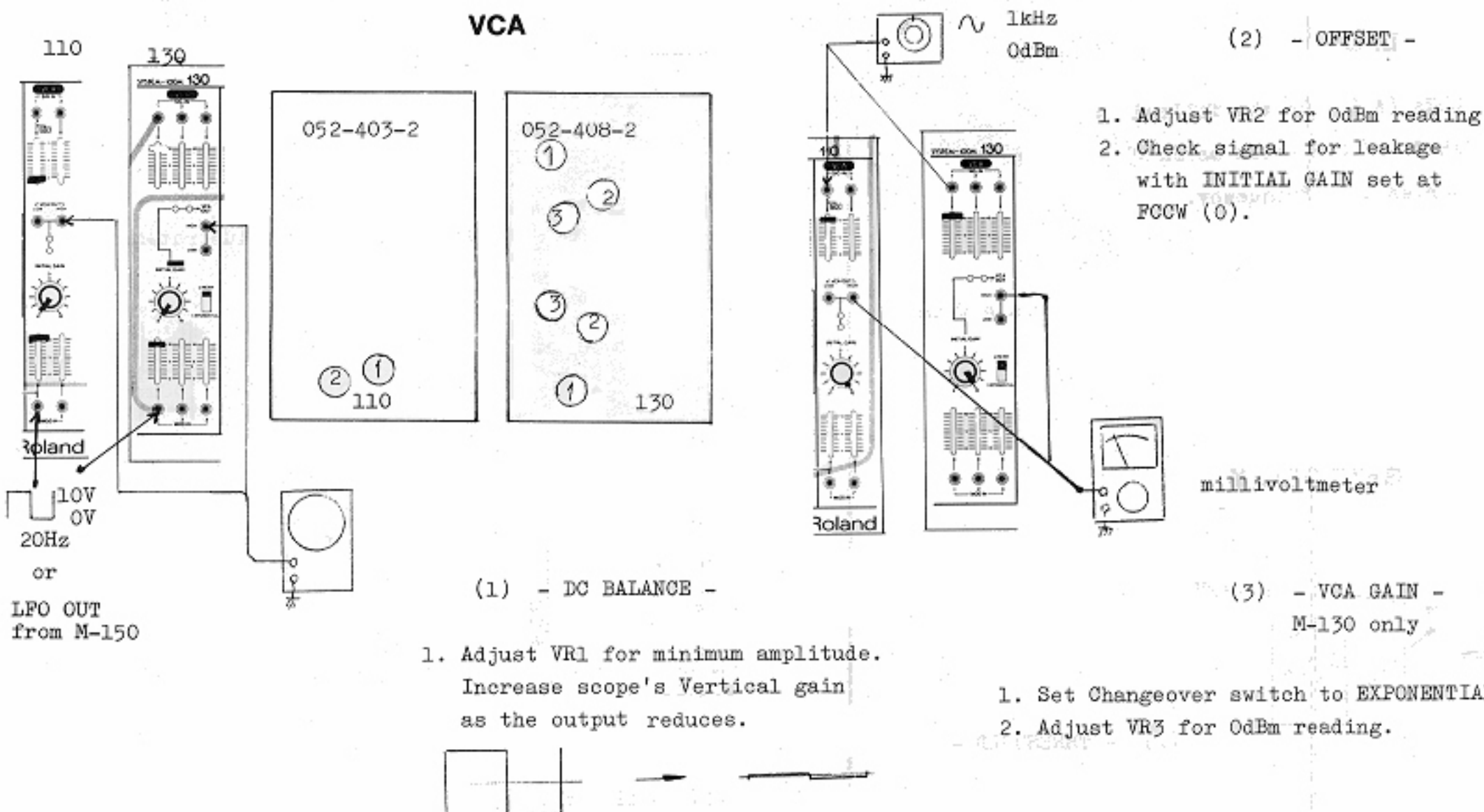
KEY DESIGNATION

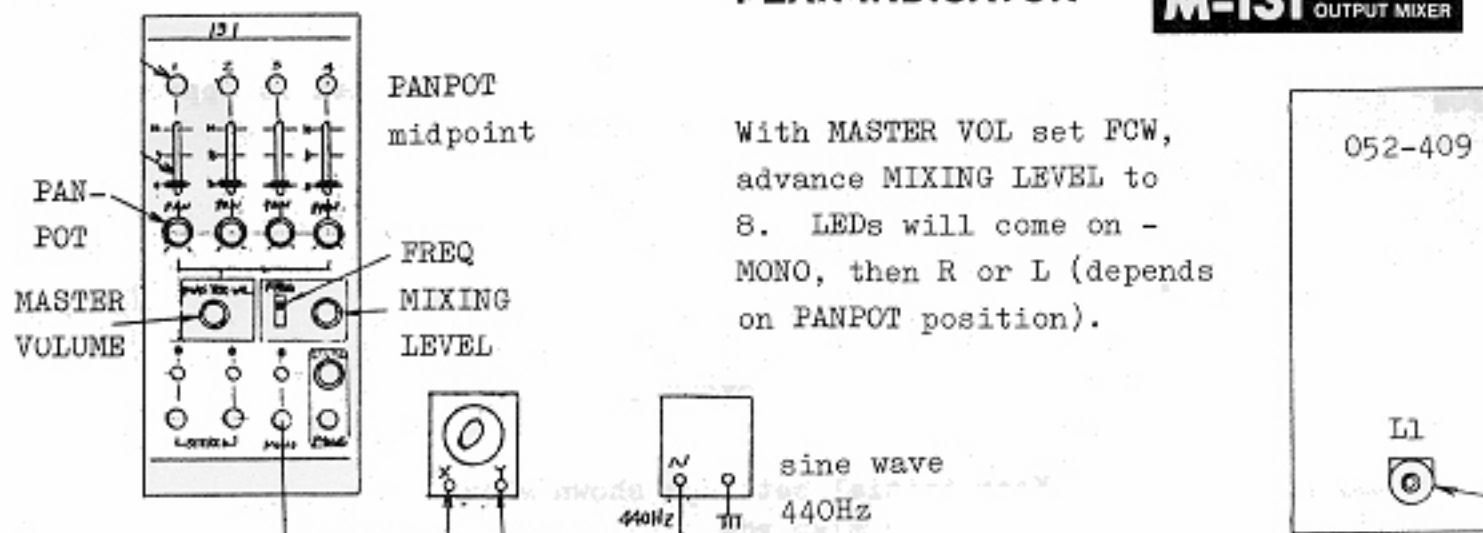
M-181

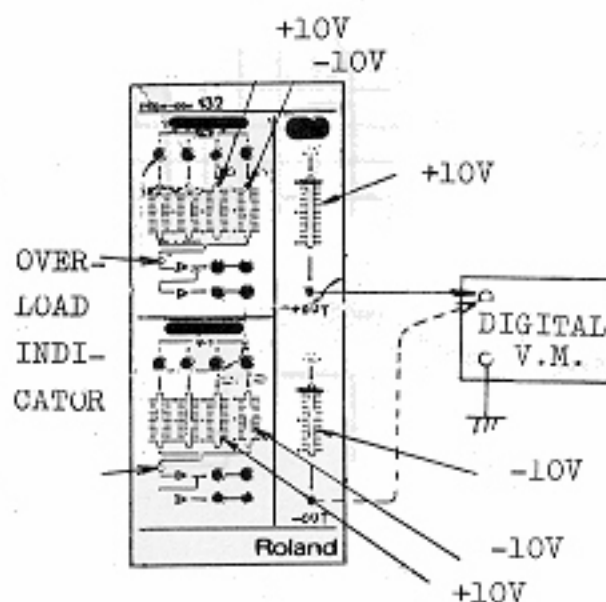


M-180



VCA

PEAK INDICATOR
M-131 OUTPUT MIXER

STANDARD OSC

M-132 DUAL CV AUDIO MIXER & VOLTAGE PROCESSOR

VOLTAGE PROCESSOR
MIXER-1.2

- OVERLOAD INDICATOR -

Check that LEDs light respectively under the following settings.

MIXER-1

SIG IN slider	
NO.4	NO.3
0	9-10
9-10	0

MIXER-2

SIG IN slider	
NO.4	NO.3
0	9-10
9-10	0

LFO
(1) - FREQUENCY -

Adjust VR1 for 30Hz (33ms).

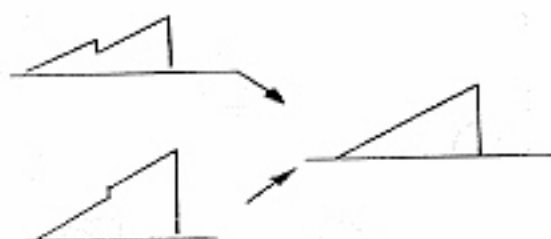
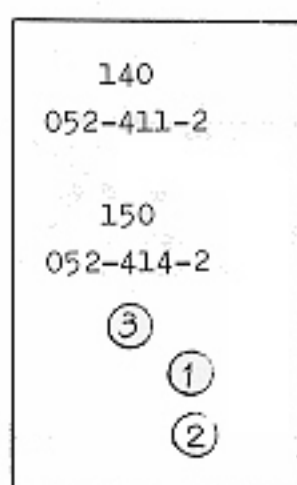
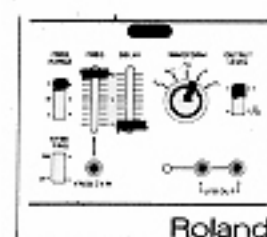
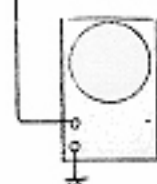
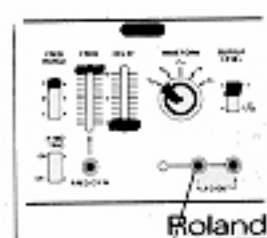
(2) - AMPLITUDE -

Adjust VR2 for 10V p-p.

Change WAVEFORM to SAWTOOTH.

(3) - SAWTOOTH -

Adjust VR3 for straightness.


M-150 RING-NOISE S/H LFO

NOISE

Adjust VR1 for 18V p-p.
(early M-150: 12-14V)

RING MODULATOR
(1) - SIGNAL BALANCE -

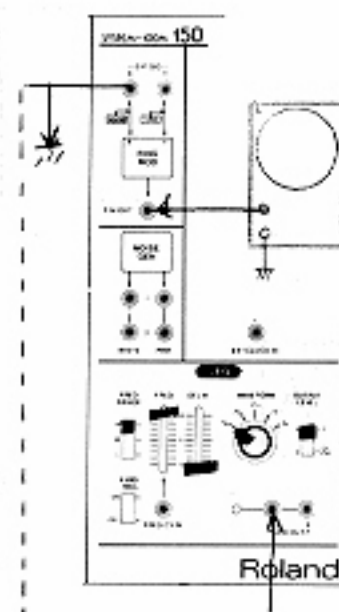
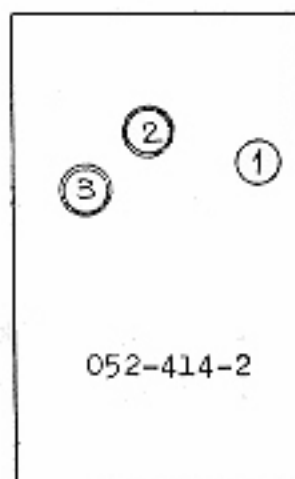
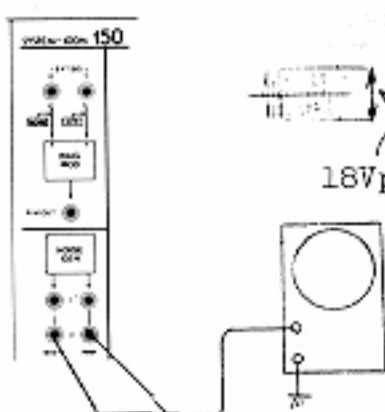
Insert short circuit plug into EXT SIG X jack to place a ground to the jack circuit.

Adjust VR2 for minimum RING OUT.

(2) - MODULATION BALANCE -

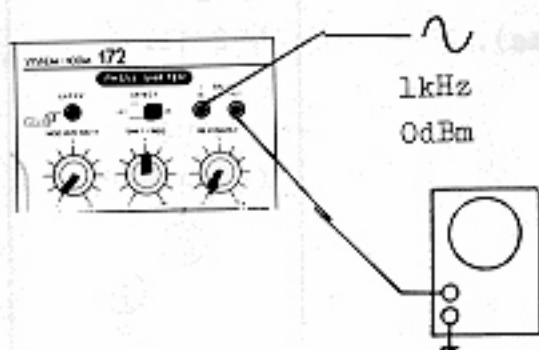
Connect EXT SIG X to LFO OUT.

Adjust VR3 for distortion free output.
Modulated waveform doubles the input in frequency.



PHASE SHIFTER

- SHIFT FREQUENCY -

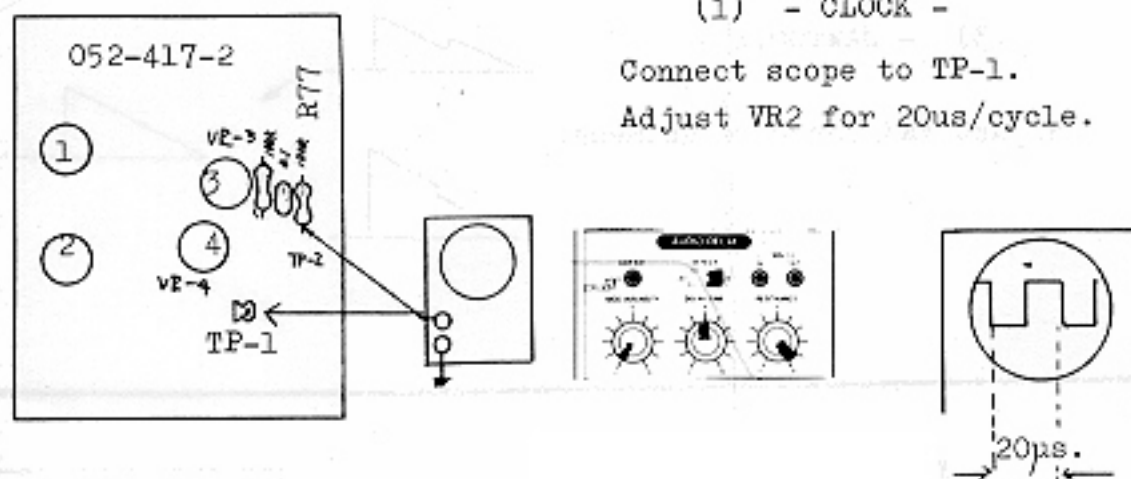


1. Rotate VR1 FCW to/from FCCW; level of PHASE SHIFTER output will decrease to minimum three times per full rotation.
2. Stop the rotation at the 2nd, and fine-tune VR1 for the minimum waveform level.

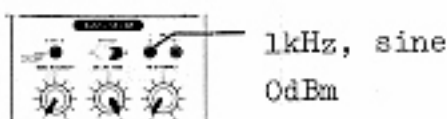
AUDIO DELAY

(1) - CLOCK -

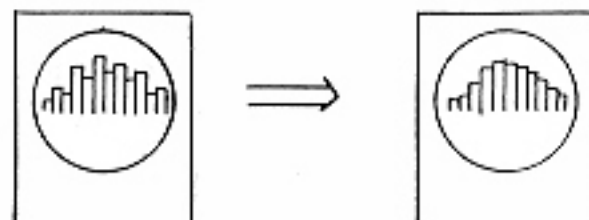
Connect scope to TP-1.
Adjust VR2 for 20us/cycle.



(2) - BBD OUTPUT BALANCE -



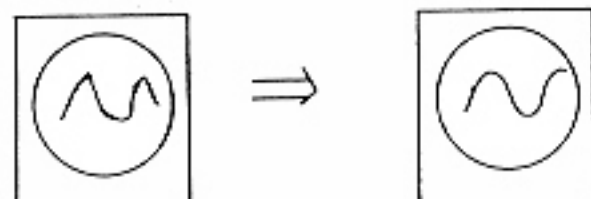
Connect scope to TP-2.
Adjust VR3 for smooth envelope.



(3) - BBD BIAS -

Connect scope to AUDIO DELAY SIG OUT.
Advance audio generator level control until some distortion occurs.

Free waveform from distortion by turning VR4.

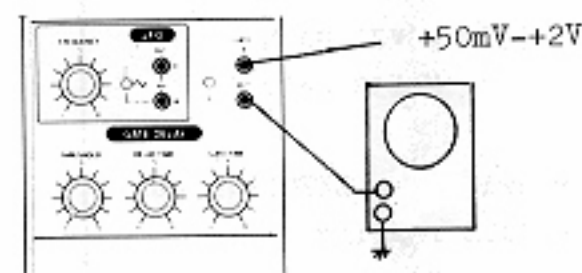


LFO

Check LFO OUTs (A,B) for the following:
Frequency shifts 0.04Hz-10Hz as FREQUENCY a
Amplitude varies with frequency.
10V p-p at 0.04Hz
400mV p-p at 10Hz

Waveforms from OUT A and B are 180° out of each other.

GATE DELAY

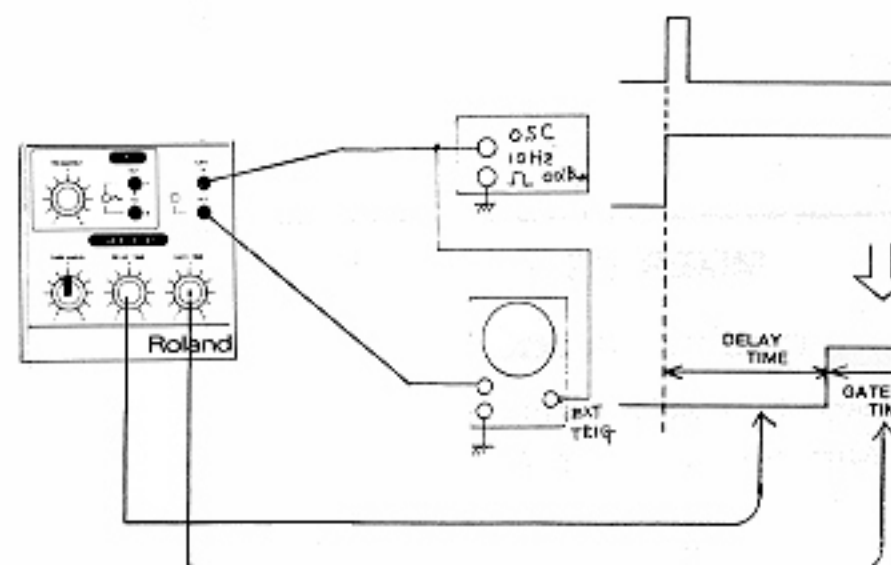


(1) - THRESHOLD

Check that GATE OUT provides +15V in the fo
input levels and settings:

input +50mV±10% . . . THRESHOLD FC
input +2V±20% . . . THRESHOLD P

(2) - DELAY TIME & GATE TIME -



Lengths of DELAY TIME and GATE TIME are as :

DELAY TIME	delay time	GATE TIME
FCCW (0)	0.3ms	FCCW (0)
FCW (10)	6s	FCW (10)

for the following:

0.4Hz-10Hz as FREQUENCY advances.

with frequency.

0.4Hz

10Hz

A and B are 180° out of phase with

E DELAY

+50mV-+2V



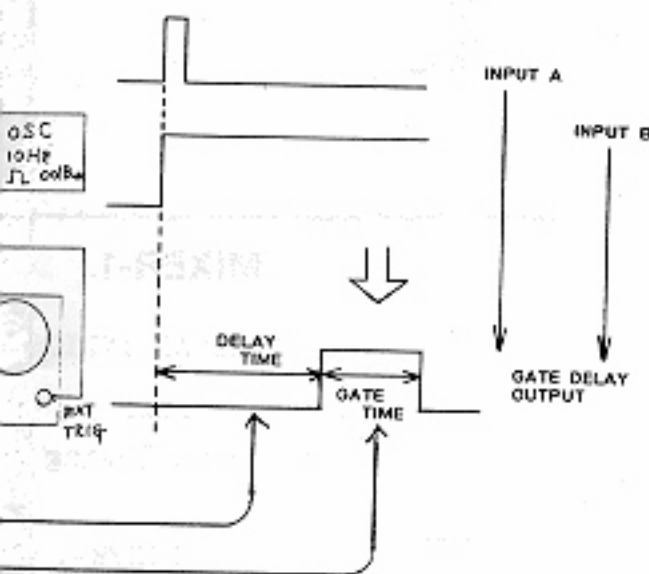
(1) - THRESHOLD -

provides +15V in the following
ings:

0% . . . THRESHOLD FCCW

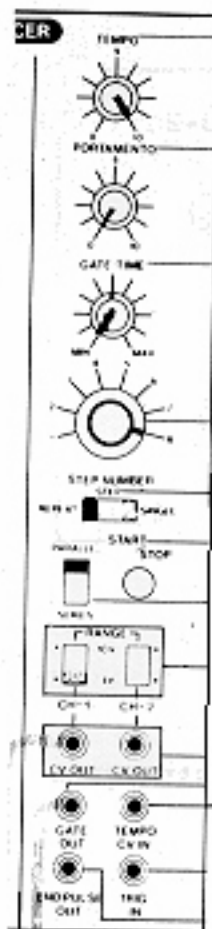
. . . . THRESHOLD FCW

TIME & GATE TIME -



and GATE TIME are as follows:

me	GATE TIME	gate time
FCCW (0)		0.3ms
FCW (10)		6s

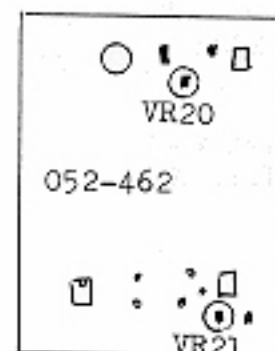
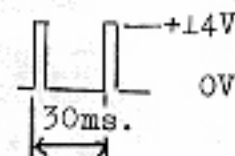


GATE

(1) - TEMPO -

Set controls as illustrated at left.

Adjust VR20 for:



(2) - LED ON/OFF TIMING -

With TEMPO at "0", a LED stays on for 7 seconds before
the next LED lights.

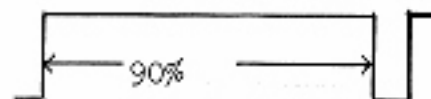
With TEMPO at "5", LED lighting duration is approxi-
mately 0.5 seconds.

(3) - DUTY CYCLE -

Keep initial settings shown above.

Turn GATE TIME FCW.

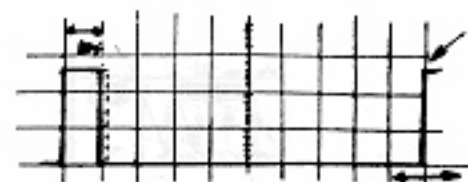
Adjust VR21 for 90±2% duty ratio.



Reverse GATE TIME (FCCW).

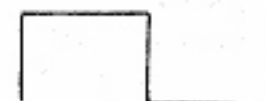
1. Adjust TEMPO to display one
cycle of waveform across ten
divisions on graticule.

2. Check that duty ratio is
8-12%.



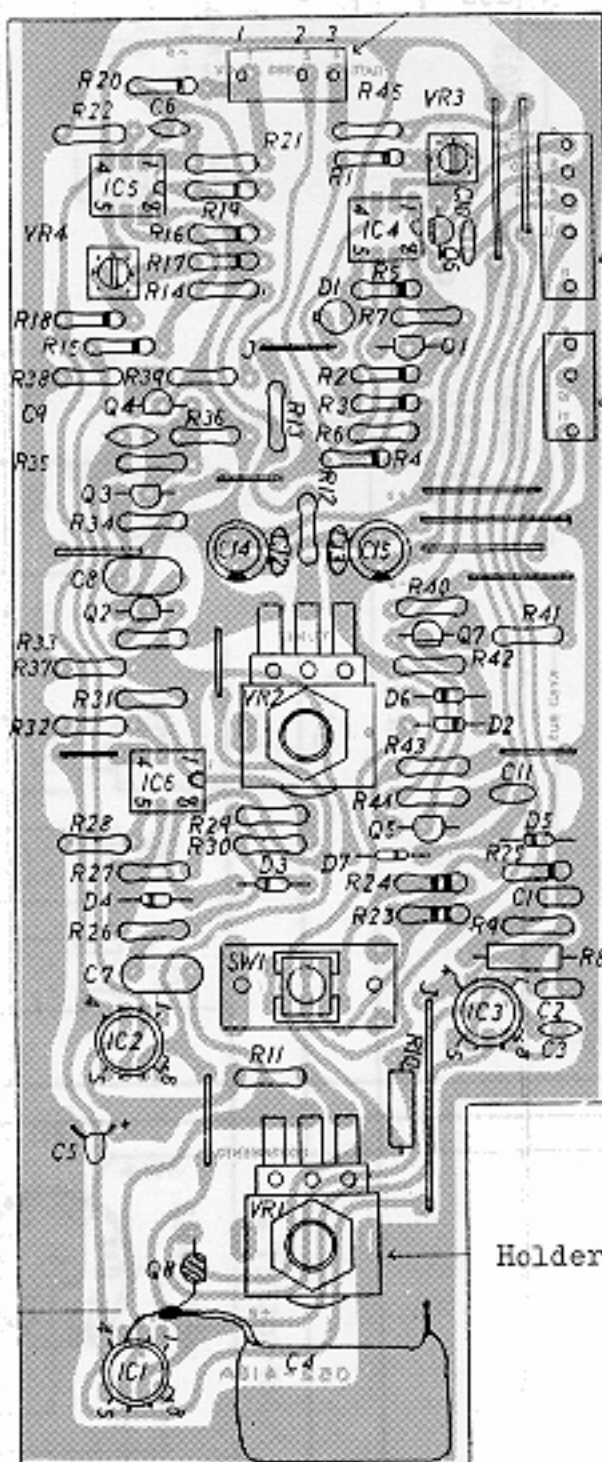
Set GATE TIME at "4".

Check that duty ratio is 50%.
(±7%)





NOMENCLATURE	PART NO.	PARTS NAME
SW- 1	13139131	SLE-623-12P(S)
VR- 1	028-720	VM10RK15(L)A26 2MA
VR- 2	028-727	VM10RK15(L)B15 100KB
VR- 3	13299504	PN82-2H202H 2KB
VR- 4	13299506	PN82-2H501H 500 ohms
IC- 1	15189131	LF13741H
IC- 2	15189121	CA3140T
IC- 3	15189109	uA301HC
IC- 4-6	15189105	uPC4558C
Q- 1-5	15129115	2SC1815-Y
Q- 6, 7	15119112	2SA1015-Y
Q- 8	15139103	2SK30ATM-GR
D- 1	15019627	1S2454 zener
D- 2-7	15019103	1S2473
C- 4	polypropylene	ECQF-2334MZ
C- 5	tantalum	1mfd 35V
R- 23,24		CRB+FX 0.1% selected
R-		CRB+FX 1%



M-180
CV-1A (159-001A)
(pcb 052-418A)

KEY-BOARD 32NOTE
SK-132B

Tunable range
±700 cents
Portamento
0-10s

Holder N-106
(H55A)

ADJUSTMENT

PB-4 (M-181 only)

When PB-4 is replaced with a factory assembled one, step 1 is negligible.

Connect a voltmeter (preferably, digital type for precise measurements) into BENDER OUT jack.

1. With PB-4 lever left at neutral, position VR-5 wiper for 0±1mV reading.
2. With the lever held at leftmost position, set VR-7 on OP-98 for -5V reading.
3. With the lever held at rightmost, set VR-6 for +5V reading.

TUNING

Connect vo

1. WIDTH
 - a. While pre
 - b. While pre
 - c. Check the

2. SHIFT

While pressi

VR-4 for 2V
3V

Ch

F1

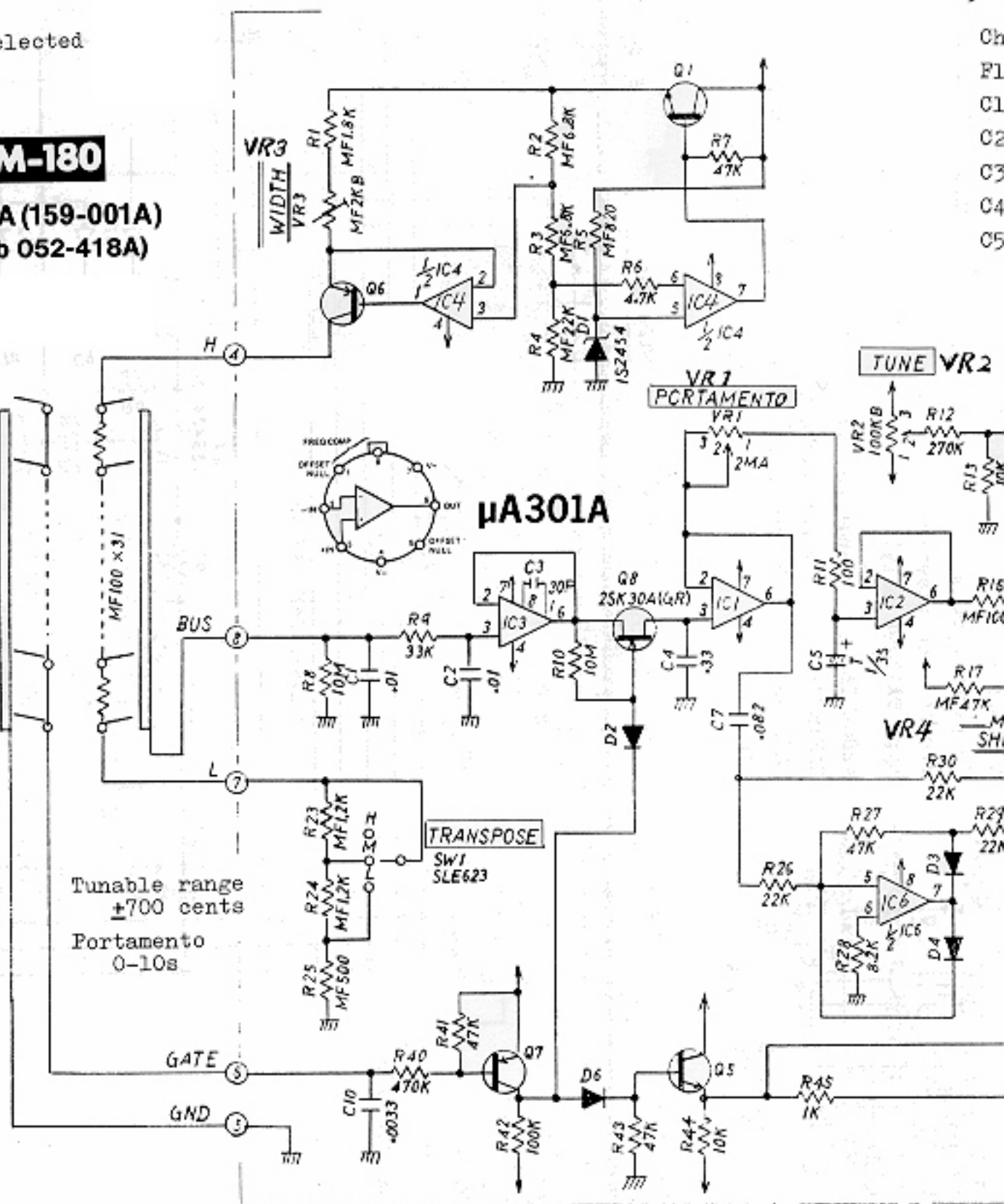
C1

C2

C3

C4

C5



FOR KEY DESIGNATIONS, SEE P. 12.

TUNING

Connect voltmeter into CV OUT.

1. WIDTH

- While pressing C2 (M-180) key, note the reading. Call this V_x .
- While pressing C3 (M-180) key, adjust VR-3 for $V_x + 1V$.
- Check that adjacent C keys are in 1V/oct relation.

2. SHIFT

While pressing C2 (M-180) key, set C3 (M-181) VR-4 for 2V reading.

Check:

$F1 = 1.416V$ (M-180)
 $C1 = 1V$ (M-181)
 $C2 = 2V$
 $C3 = 3V$
 $C4 = 4V$
 $C5 = 5V$ (M-181)

current draw
 40mA +15V
 20mA -15V

3. TUNABLE RANGE

CV should lower by 0.5V when TUNING VR-2 is turned from 0 point to FCCW, and should rise by 0.5V when VR-2 turned 0 to FCW.

4. TRANSPOSE

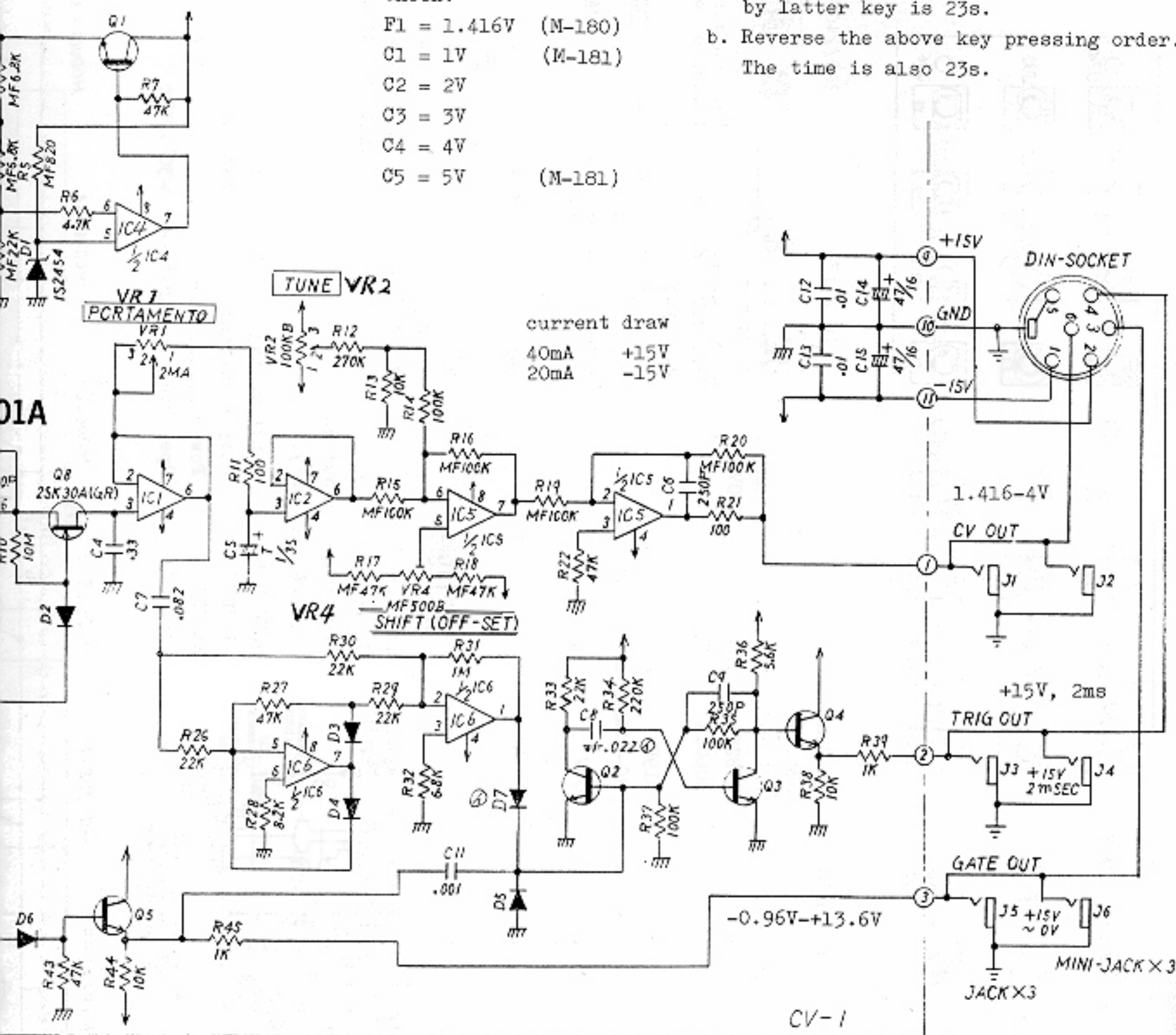
CV should vary by 1V when TRANSPOSE is set from M position to L or H.




5. PORTAMENTO

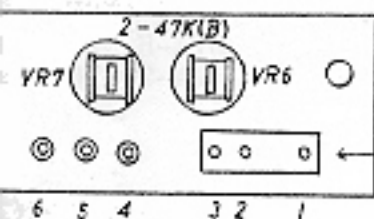
(M-181 - SW-2 on -)

Turn PORTAMENTO fully clockwise.

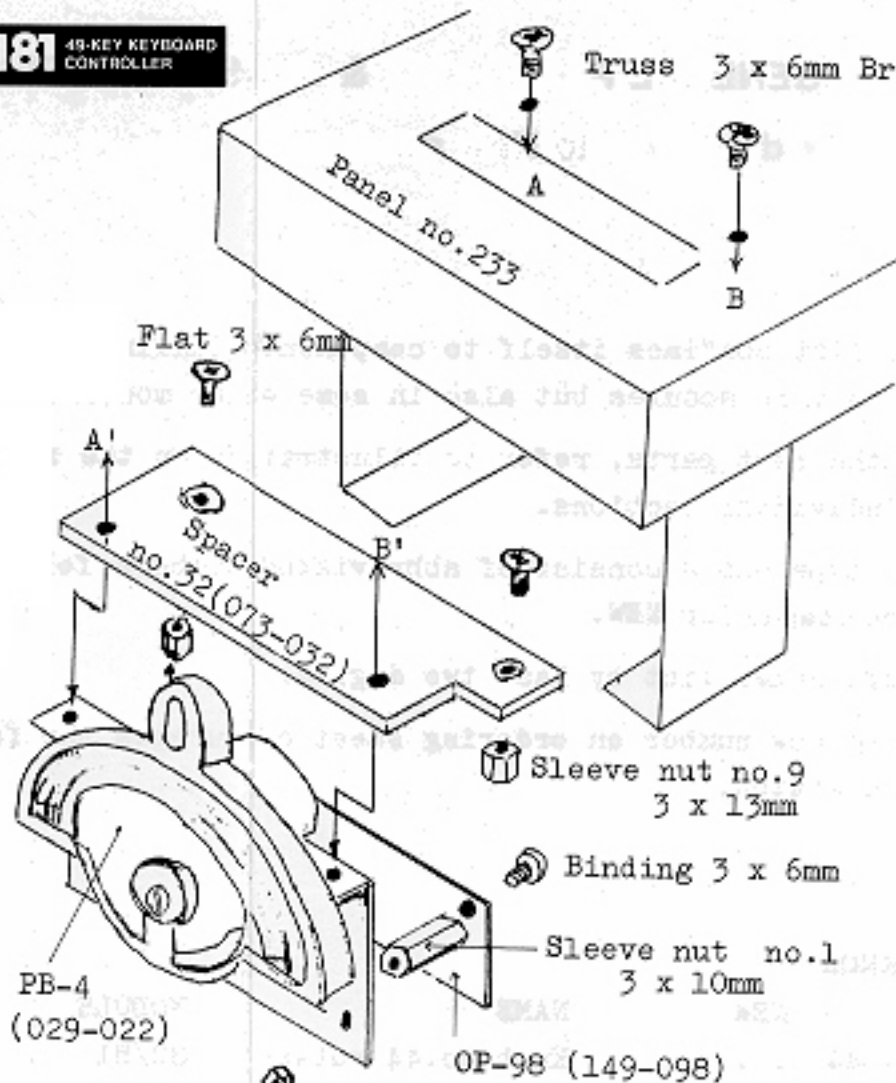
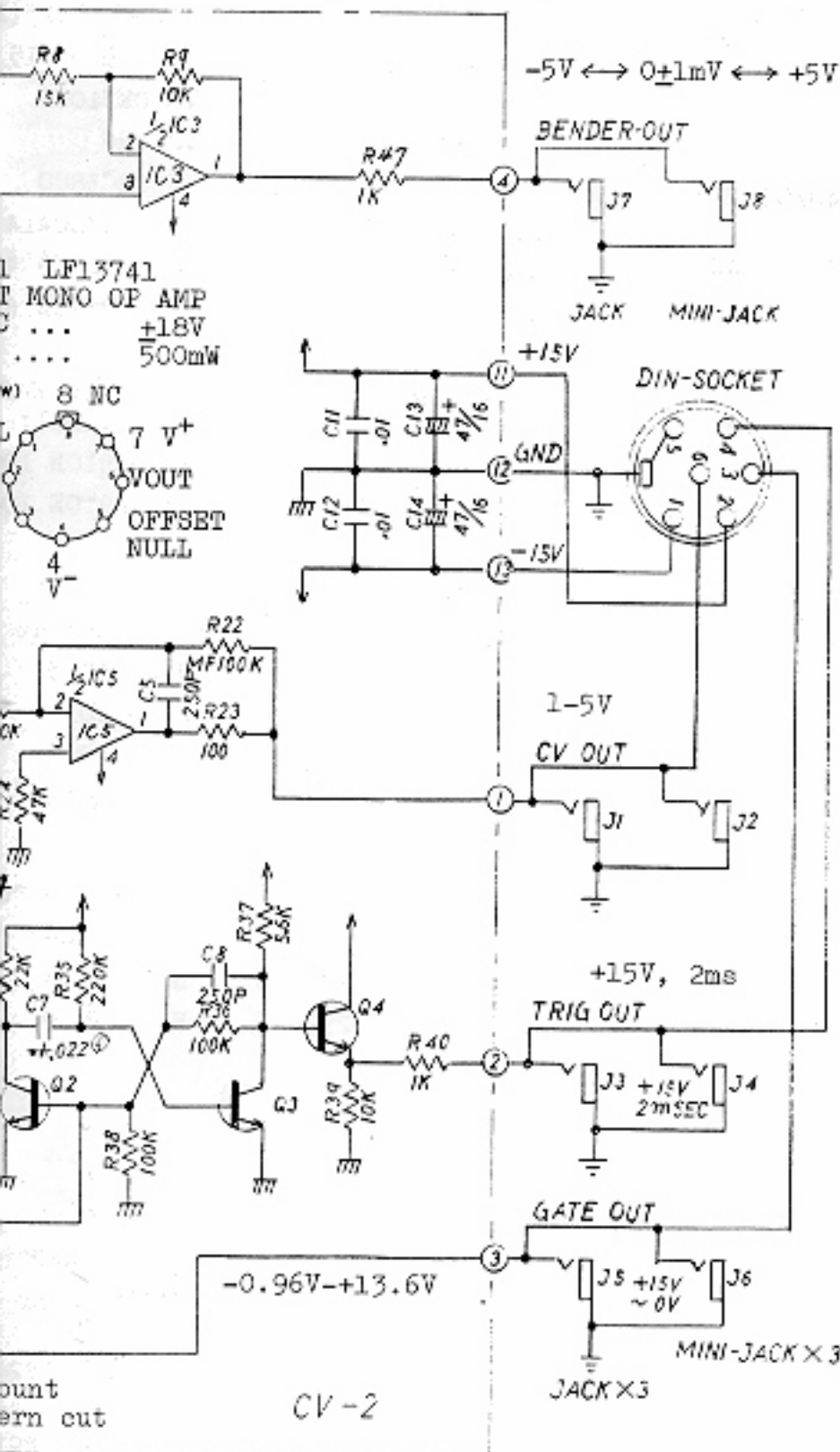
- Press the lowest key, then, the upmost key. The time required for CV to reach the voltage specified by latter key is 23s.
- Reverse the above key pressing order. The time is also 23s.



Q-	1-5	15129115	28C1815-Y	
Q-	6, 7	15119112	28A1015-Y	
Q-	8	15139103	28K30ATM-GR	
D-	1	15019627	1S2454	zener 
D-	2-7	15019103	1S2473	
R-	25, 26		CRB $\frac{1}{4}$ FX	0.1% selected
R-			CRB $\frac{1}{4}$ FX	metal film

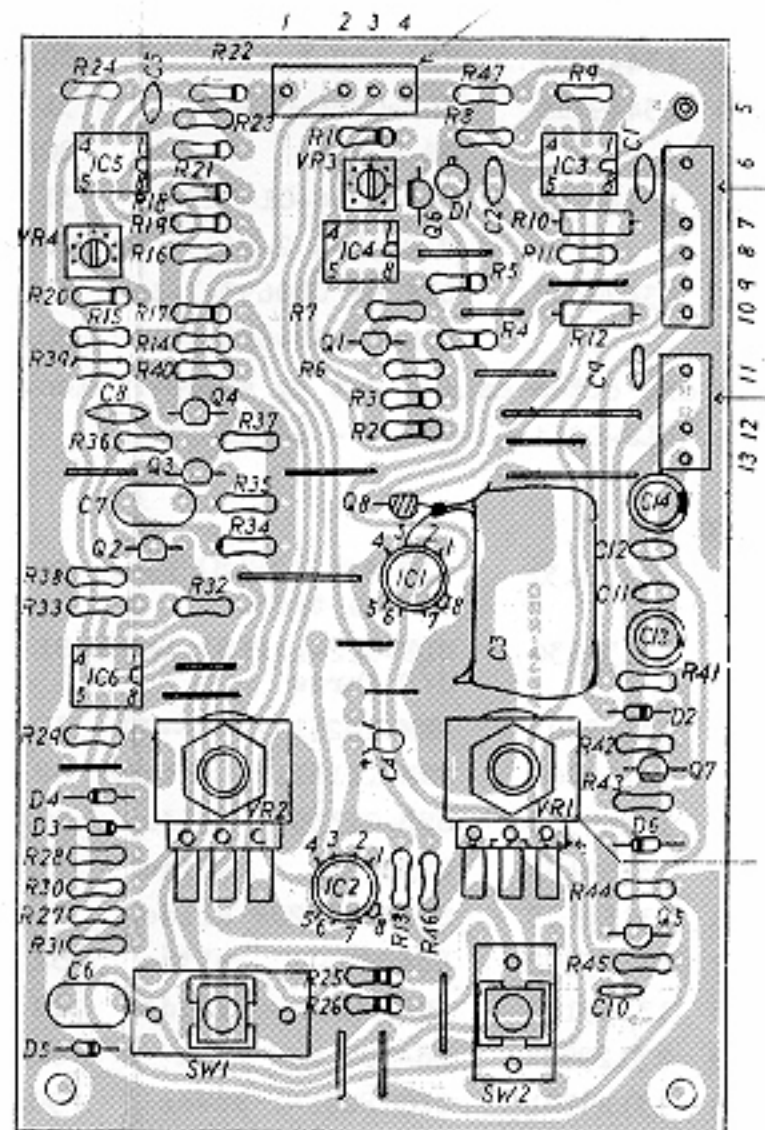


OP98 (149-098)
(pcb 052-420)

**M-181**

CV2A (159-002A)
(pcb 052-419A)

```
current draw
40mA      +15V
20mA      -15V
```



6. TRIG OUT

While depressing a key, tap the lower key. This keyings should cause TRIG OUT to send out pulses each time the contact closes and opens.

CA3140

MOS/FET Input Bipolar Output

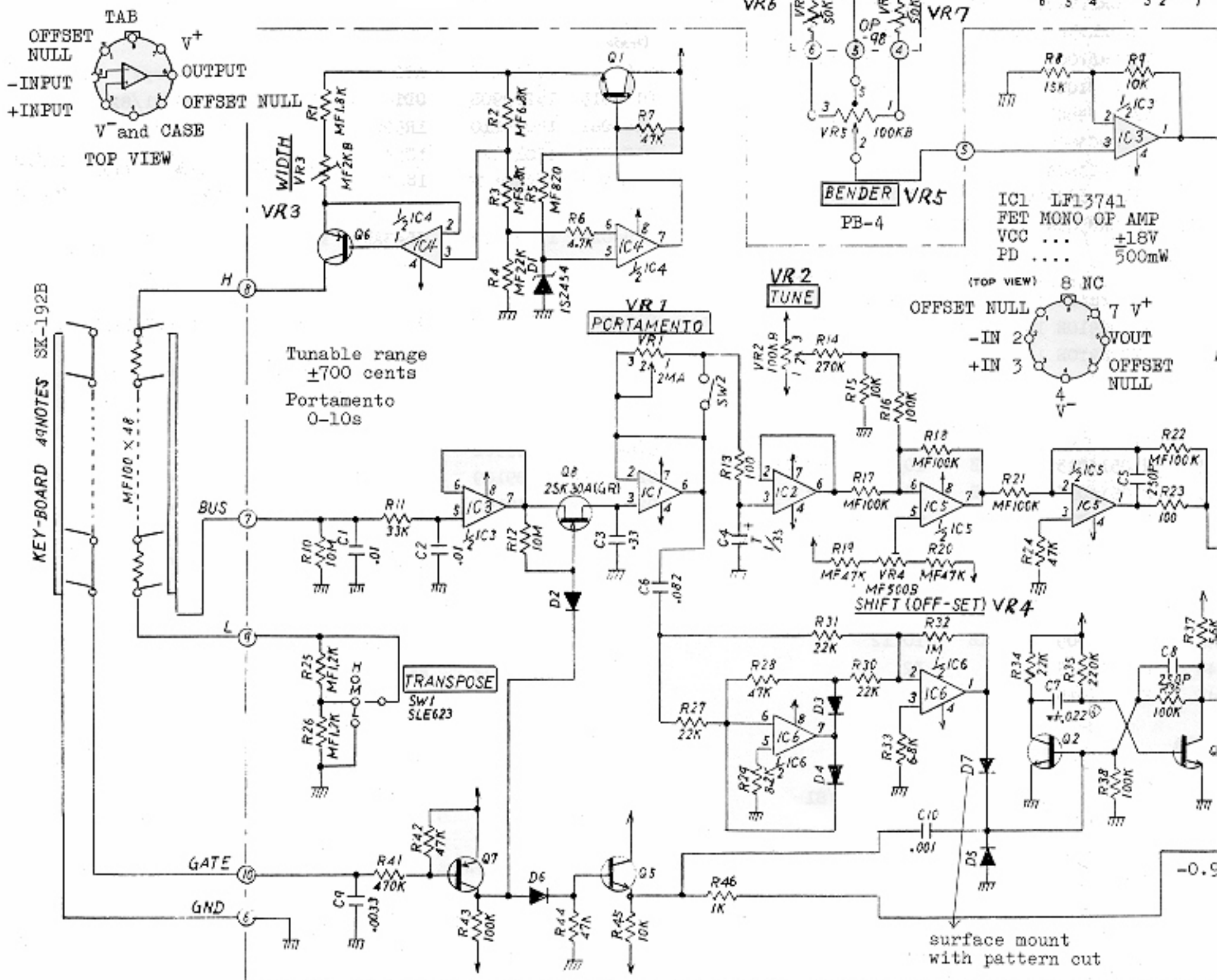
DC Supply Voltage . . . 36V
(Between V⁺ and V⁻ terminals)

Differential-mode
Input Voltage . . . +8V

Input Terminal Current . . 1mA

NOMENCLATURE	PART NO.	PARTS NAME
SW- 1	13139131	SLE-623-12P(S)
SW- 2	13139130	SLE-622-12P(S)
VR- 1	028-720	VM10RK15A26 2MA
VR- 2	028-727	VM10RK15B15 100KB
VR- 3	13299504	PN82-2H202H 2KB
VR- 4	13299506	PN82-2H501H 500
VR- 5	029-022	PB-4 assy
VR- 6, 7	13299116	SR19R 47KB
IC- 1	15189131	LF13741H OP amp
IC- 2	15189121	CA3140T
IC- 3-6	15189105	uPC4558C

Q-	1-5	1
Q-	6, 7	1
Q-	8	1
D-	1	1
D-	2-7	1
R-	25, 26	
R-		
C-	3	pa
C-	4	ts



GENERAL PARTS LIST & CROSS-REFERENCE

Old number to New number

This list confines itself to components finding applications not only in modules but also in some other models.

For the rest parts, refer to illustration on the front cover or individual sections.

Some type names consist of abbreviated numbers following N- which stands for NEW.

Module names list by last two digits.

Use of new number on ordering sheet encourages the factory for dispatch.

Knob

OLD	NEW	NAME	MODULE
016-044	. . .	Knob no.44 rotary	80/81
016-077	2247012700	Knob N-127 rotary	31/82
016-078	2247012800	Knob N-128 rotary	10/12/30/31/40/50/72/82
016-079	2247012900	Knob N-129 slide	10/12/21/30/31/32/40/50

JACK, SOCKET

009-039	13449402	SJ-409-1-2	10/12/21/30/31/32/40/50/72/82/90/91
009-015	13449111	HLJ-102-1-4	80/81/90/91
009-030	13449115	HLJ-0264-01-030	31
009-007	. . .	SG-8050#4	80/81
009-040	13449114	HLJ-0264-01-020	31
009-016	. . .	P-254P-4 2-pin	90/91
012-037	13429603	DIN 8P CS0690-1-1	all but 90/91
009-036	. . .	DIN 6P CS-660-1-1	80/81/90/91

*Jacks are often called out by abbreviation. So are switches.
exp. HLJ-0264-01-030 --- LJ-264-1-3

SWITCH

. . .	13139131	SLE-623-12P(S) lever	80/81
		single throw	
. . .	13139130	SLE-622-12P(S) lever	81
		U/D throw	
001-214	13119401	SRM-1025172 rotary	10/12/40/50
001-272	13119702	SRM-1018112 rotary	82
001-183	13159304	SSB-02335 slide	10/12/40/50
001-182	13159103	SSB02242 slide	12/30/40/50/72
001-228	13159503	SQPR240120P slide	21/31 (abbr. SQPR24-12P)
001-177	13159302	SSA04301 slide	82
001-176	13159102	SSA04202 slide	82
001-049	13129901	DS-102 red push	40/82
001-215	13129101	SDG5P001-1 power	90/91 100V
001-216	13129102	SDG-5P001-2	90/91 117V
001-217	13129103	SDG5P502	90/91 220/240V

OLD NO. NEW NO. PART NAME MO

POTENTIOMETER

Slider

029-519	13339301	EVA-HO4C15A15	100KA	10
029-521	13339305	EVA-HO4C15A55	500KA	50
029-522	13339302	EVA-HO4C15A16	1MA	50
029-531	13339304	EVA-HO4C15B15	100KB	10
029-523	13339303	EVA-HO4C15A26	2MA	40
029-543	13339401	EVA-TOAC15A15	100KA	10
029-555	13339402	EVA-TOAC15B15	100KB	10
029-570	13339403	EVA-TOAC15D16	1MD	40
029-571	13339404	EVA-TOAC15D26	2MD	40
029-022	. . .	PB-4 assy		81
		EVA-H	20mm stroke	
		EVA-T	30mm storke	

Rotary

028-720	. . .	VM10RK15A26(L)	2MA	80
028-727	. . .	VM10RK15B15(L)	100KB	80
028-763	13219220	VM10RB10CB15	100KB	10
028-762	13219219	VM10RB10CB54	50KB	72
028-760	13219225	VM10RC38CB14	10KB	72
028-774	13219226	VM10RC38CC15	100KC	72
028-749	13219222	VM10RC38CA14	10KA	72
028-756	13219221	VM10RC38CA26	2MA	72
028-755	13219223	VM10RC38CA16	1MA	82

*VM10RC38C/10RB10C shaft: K-20 (20mm len
GM70R910E terminal: L shaped po

028-664	13219806	GM70R910E	100KA/100KC
028-665	13219807	GM70R910E	100KB x 2

Trimmer

Carbon solid formerly named as "SR19R"

030-465	13299114	H1051A013	10KB	10
030-467	13229115	H1051A015	22KB	10
030-469	13299116	H1051A016	47KB	72
030-471	13299117	H1051A019	100KB	10

Metal glaze formerly named as "CR19R"

030-491	13299542	H1021A009	2.2KB	10
030-497	13299544	H1021A015	22KB	32
030-501	13299546	H1021A019	100KB	5

Tantalum thin film

030-625	13299501	PN822H101H	100B	10
030-630	13299504	PN822H202H	2KB	10
030-631	13299506	PN822H501H	500B	80
030-632	13299507	PN822H502H	5KB	10
030-636	13299508	PN822H503H	50KB	10

Zener diodes 1S2453, 1S2454

Application is thermal drift compens
indicates identical electrical chara
is provided with low temperature coe
be a good replacement for 1S2453.

NAME	MODULE	OLD NO.	NEW NO.	PART NAME	MODULE
SEMICONDUCTOR					
Transistor					
H04C15A15 100KA	10/12/21/30	017-010	15129801	2SD234-0	90/91
H04C15A55 500KA	50	017-012	15119106	2SA733-Q	72/82
H04C15A16 1MA	50	017-013	15129107	2SC945-Q	72/82
H04C15B15 100KB	10/12/21/30/32/40/50	017-016	15139103	2SK30ATM-GR FET	10/21/30/40/50/80/81/82
H04C15A26 2MA	40/50	017-0168	15139103A	"SK30ATM-GR selected on gm base	72
TOAC15A15 100KA	10/21	017-022	15119800	2SB434-0	90/91
TOAC15B15 100KB	10/21/31/32/40	017-039	15139110	NF510	10/12
TOAC15D16 1MD	40	017-046	151291050A	2SC828R NZ selected	50
TOAC15D26 2MD	40	017-105	15119112	2SA1015-Y	10/12/21/30/31/32/40/50/80/81
assy	81	017-110	15129115	2SC1815-Y	10/12/21/30/31/40/50/80/81
H 20mm stroke		017-124	15119108	2SA798-G	82
T 30mm storke					
RK15A26(L) 2MA	80/81	Diode			
RK15B15(L)100KB	80/81	018-014	15019103	1S2473	except 90/91
RB10CB15 100KB	10/12/30/31/72	018-015	15229908	SDT-1000 thermistor	10/21/82
RB10CB54 50KB	72/82	018-061	15019210	1R5BZ61 100V 1.5A	90/91
RC38CB14 10KB	72	018-078	15019625	1S2453	zener 6-7V 250mW @ 10mA 10/12
RC38CC15 100KC	72	018-079	15019627	1S2454	see below center 80/81
RC38CA14 10KA	72	LED			
RC38CA26 2MA	72	019-020	15029109	GL-3AR-2 red	72/82
RC38CA16 1MA	82			LR0601R red	90/91
ft: K-20 (20mm length w/serrations)			* LR --	longer leads	
rminal: L shaped pc type		019-022	15029110	GL-3AR-1 red	10/12/21/30/31/32/40/50
R910B 100KA/100KC	31	019-023	15029111	GL-3PG-1 green	10/21/30
R910B 100KB x 2	31	IC			
amed as "SR19R"		020-001	15199502	TA-7066AP	31
LA013 10KB	10/12/21/50/72	020-024	15189109	uA301HC	10/31/80
LA015 22KB	10/12/30/72	020-032	15219101	uA726HC	10/12
LA016 47KB	72/81/82	020-040	15159104T0	TC4011BP	82
LA019 100KB	10/12/21/30/40/50	020-041	15159105T0	TC4013BP	31/72/82
	90/91	020-063	15219203	MN3004 BBD	72
ed as "CR19R"		020-026	15219106	LM1496N	50
LA009 2.2KB	10/12	020-096	15229803	BA662B	10/30/40/50
LA015 22KB	32	020-160	15229802	BA662A	10/21
LA019 100KB	50		*BA662A can replace BA662B		
		020-097	15189105	uPC4558C	all except 90/91
2H101H 100B	10/12	020-100	15189118	TL082CP	10/12/40/50/82
2H202H 2KB	10/12/80/81	020-105	15189121	CA3140T	82/80/81
2H501H 500B	80/81	020-152	15189102	NJM4558DD	72
2H502H 5KB	10/12	020-165	15219109	NE-555P	72
2H503H 50KB	10/12	020-167	15159107Z0	MC14022B	82
		020-194	15159102T0	TC4001UBP	82
es 1S2453, 1S2454		020-228	15199110T0	TA7179M	90/91
ermal drift compensation. Although		. . .	15189131	LF1374H	80/81
al electrical characteristics, 1S2454					
low temperature coefficient and can					
ment for 1S2453.					